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6112-6-57

VOL. 40, No. 3 MARCH 1959

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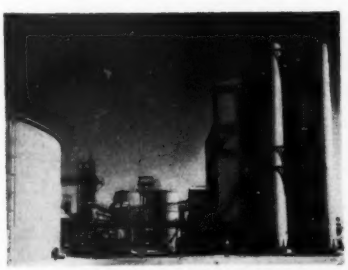

This Month's Cover

New Bartlett, California, plant of Columbia-Southern Chemical Corporation situated near Owens Lake, source of raw materials for soda ash. Two storage bins appear in center; settling towers (right) convert sodium carbonate to sodium sesquicarbonate.

THE GLASS INDUSTRY

An Ogden Publication Devoted to Glass Technology, Engineering, Materials and Glass Factory Equipment and Operations

Published by
OGDEN PUBLISHING COMPANY
55 West 42nd Street, New York 36, N. Y.
K. W. OGDEN, Owner

Editor	**FRANK S. CHILD**
Advertising Director	**ROBERT M. OGDEN**
Production Manager	**IRENE ANNE YUSS**
Circulation Manager	**JOSEPH A. TEDESCO**
Midwest Representatives	**Macintyre-Simpson & Woods 75 East Wacker Drive, Chicago 1900 Euclid Ave., Cleveland**
England	**T. J. Scott & Sons Ltd. 1 Clements Inn, Strand London WC 2.**

THE GLASS INDUSTRY is published monthly by Ogden Publishing Company, 55 West 42nd Street, New York 36, N. Y. Subscription $4.00 a year. Canada and Foreign $5.00. Single copies 50 cents domestic; 60 cents Canada and Foreign. Issues over three months old 70 cents; over one year, $1.50; over five years, $2.00. Second class mail privileges authorized at New York, N. Y.

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Instrumentation in the Glass Industry in Great Britain

By LEO WALTER, Consulting Engineer

Gloucester, England

• THE GLASS MANUFACTURING INDUSTRY in Great Britain has made great progress in instrumentation of plant equipment during the past decade. In general, this progress seems to have developed along lines similar to that made in glass manufacture in America.

The target for the future is certainly similar in both countries: the desire for automatic control of end-product quality in all glass production. The petroleum and petrochemical industries are leaders in this particular phase of automation. By continous—and automatic—end analysis, and through the use of electronic computers, attempts are being made to achieve optimum control of processing units.

The glass industry has not gone this far yet; nevertheless, automatic control of process "variables" is proceeding at an ever-increasing speed. The urgent necessity to reduce prices at competitive levels sponsors automation.

The next best thing to this desirable target is the use of better instrumentation in conjunction with modern machinery. For example, feeder control of high-speed bottle machines uses detectors which sense change of heat from a change in heat radiation. Electronic magnification of electric control impulses, received from changes in radiant heat output, hold the desired plant conditions steady. (Fig. 1).

Blow temperature for bottle machines is closely controlled by means of temperature-sensing elements located in the air stream. Blowers for cooling are thus regulated at will; electronic air damper control is rapid and exact.

Figure 2 illustrates a control scheme developed by one of the leading British instrument firms. The diagram shows a section through a glass tank and a feeder. The scheme is typical for similar installations in Great Britain and should be described in some detail.

Automatic Temperature Control

Forehearth and spout section temperature control uses thermocouples located below the glass surface. Although a sheath causes a slight delay or time lag in detecting temperature changes by the hot junction of the immersed thermocouple stem, many plant engineers prefer using sheaths because of easier withdrawal of the stem.

Some use bare thermocouples having thicker wires. These can be directly immersed, and they withstand the flow of glass. Bare thermocouples react very quickly to temperature changes, but require more frequent replacement than sheathed thermocouples.

More recently the radiation pyrometer types have been widely used, mainly in connection with electronic controller types. The focussing tube, of course, has to be air-purged.

The diagram in Fig. 2 shows control of feeder-glass-temperature, using an electronic self-balancing control mechanism. Air supply to the feeder is regulated by a three-term pneumatic controlling unit, applying feed-back control mode. A diaphragm-operated control valve proportions the flow of gas fuel and combustion air supplied to the burners. An inspirator system provides correct admition and mixing of air to gas.

Spout temperature control performed in this way deals with normal temperature changes in the feeder. Accuracy of control in the region of $\pm 1°C.$ can be obtained under favorable working conditions.

Level changes, however, would adversely affect this

Fig. 1. Temperature regulators installed on feeder forehearth.

simple control method. For this, and other reasons, very close level control becomes necessary. The interlocking of alterations in glass level with consequent weight variations produced from change in glass temperature are well known to the practical production engineer. Some form of cascade control is, therefore, very desirable to offset temperature changes resulting from variations of glass level, with consequent weight variations (Fig. 2a).

Every factor which adversely affects the glass level has to be eliminated. Furnace pressure, for example, can influence level control in the feeder. Control of this process variable is not difficult and is carried out by measuring pressure in the combustion chamber actuating position of the stack damper (see sketch).

Some firms apply as the pressure-detecting element a metallic diaphragm. Others use an inverted immersed bell and perform pneumatic or electronic-pneumatic control. The system is shown in simplified form in the diagram, but may have in practice feedback control for the stack damper.

Glass Level Control

As is well-known, most batch-charging machines have favorable control characteristics. Sensing of changes in level (Fig. 2b) are used for automatic feed control. The number of detecting elements of level changes varies from special floats located in the feeder space to modern radio-isotopes. The element is clamped on a feeder wall containing a suitable source of radiation. On the opposite wall is a corresponding detecting element, producing control signals. The latter can be electronically magnified and is used to actuate a regulating unit for feed control.

In the following a detecting element will be described developed by George Kent Ltd. of Luton, England. The sensing part consists of an electrode immersed in the molten glass. This is used as the electric conductor.

This floatless method of detecting level changes is well-known and is used for liquor-level control. The application of this method to molten glass had to be developed and is the result of research combined with practical experience.

The special dip-electrode is lowered until contact is made with the glass and a circuit is completed; an electronic instrument is then switched into circuit and any out-of-balance from the previous cycle causes the measuring pointer and recording pen to move. Changes in the region of 0.001 in. (0.025 mm) can be detected, and if an automatic controlling unit is connected to the batch charger the rate of charge is automatically adjusted to maintain a constant level.

An electric motor drives the probe toward the glass surface; when contact is made, a circuit stops the motor drive and switches in a magnetic brake to prevent motor over-run. While the electrode is travelling toward the glass surface a slidewire resistance is mechanically coupled to the probe drive and forms two arms of a bridge circuit; the other two arms of the bridge circuit are in the electronic instrument. When the drive-motor stops the complete bridge circuit is switched in; any out-of balance of the bridge is corrected by the electronic circuit moving the slidewire resistance in the recorder.

After some seconds the drive-motor is switched into circuit in the reverse direction, and the probe is lifted away from the glass. As it rises, a string of glass attached to the probe is drawn out. When the electric resistance of the thread reaches a pre-determined high level, the motor is again automatically reversed and

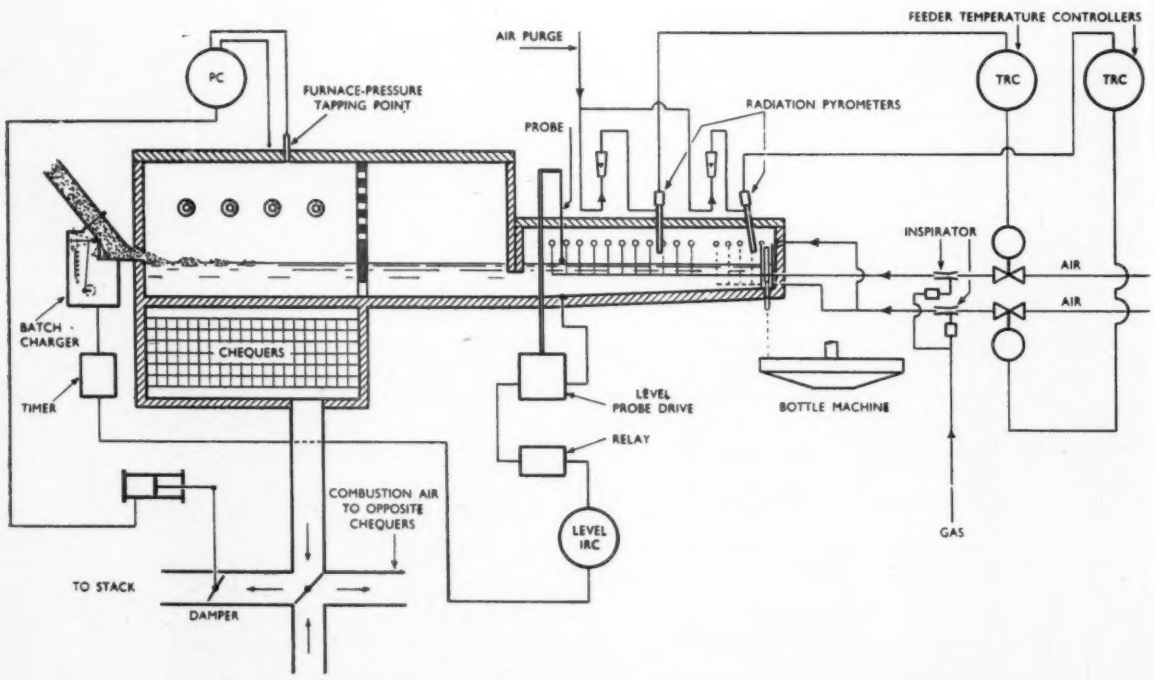


Fig. 2. Control hook-up, showing section through glass tank and a feeder, with various controls.

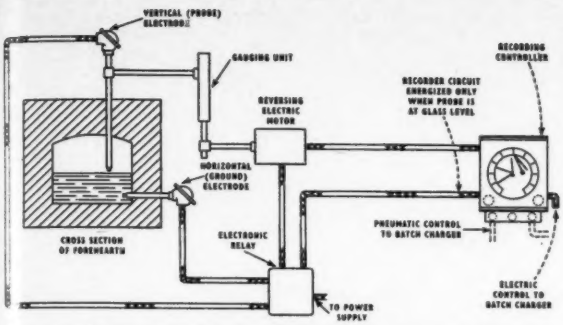


Fig. 2a. Schematic diagram of glass level control system.

drives the probe toward the glass once more. There is therefore a continuous cycle of operation, a measurement being made every 20 seconds.

In the electronic indicator-recorder may be fitted either a pneumatic three-term controlling unit, operating a power cylinder adjusting the speed of the batch chargers, or, for intermittent batch chargers, two-step contacts to start and stop the batch-charger circuits on a previously set time basis. Extremely close control of level is obtainable with the system described, the variations being in the order of 0.01 in. (0.254 mm). Fig. 3 illustrates a Kent electronic instrument for recording and controlling glass level.

Furnace Periscope

A new portable water-cooled periscope is being made by the Foster Instrument Co. Ltd. of Letchworth, England, for internal inspection of furnace chambers. Known as the Babcock-Foster Periscope, it is available as Model A in two operative lengths, 2 ft. 5 in. and 3 ft. 10 in. Figures 4a and 4b. Model B is made only in the shorter length. The entire apparatus, with water, can be carried by one man. Up to 15 minutes of observation is possible before the water requires either cooling or renewing.

Model A allows direct-forward or right-angle viewing by simply changing the screwed plugs situated at the objective end. Model B affords a 25° forward view from the right angle. The periscope can be used where suitable apertures of about 2 inches or more are available. The focussing eye-piece allows for viewing from close-up to infinity.

Glass Feeder Temperature Control

Automatic feeder temperature control is essential for economy. Several British instrument (Fig. 5) makers have dealt with problems arising from the fact that very close control is not easy to achieve. The question of process and instrument time lags had to be solved before practical control systems came into operation.

Highly accurate temperature-sensing elements (Fig. 5a) coupled to quick-acting control instruments were the prerequisite to efficient control systems. Instrumentation has now been devised which not only deals quickly with slight tendencies in temperature deviation but also actuates vigorously and promptly with any major upset. Reducing time spent in diverting temperature to a new control point during a change of job has been achieved.

Control elements are often slide-wire units with circuit-holding low contact, and auxiliary high contact. The following features are essential for glass feeder applications: A dial to adjust instrument circuit to detecting Rayotube unit; automatic current standardization at 12-minute intervals; and special shielding of measuring circuit. Chart ranges for recorders are available from 650-1400° F. up to 1300-3000° F.

Automatic Temperature Scanning

New equipment made by Fielden Electronics Ltd. of Manchester, England, has been developed for automatic scanning of temperatures (Fig. 6). This system should be of interest to the glass industry for monitoring all temperature points in the plant regularly.

The temperature is indicated on a central point on a large dial approximately 2 feet in diameter. Around the periphery of this dial are the point numbers, which may extend from 1 to 50. A motorized scanning switch examines each temperature point in the works in turn. A clear perspex pointer, tipped black, indicates the number of the point under examination. The value of each set point is shown by a red pointer. The actual measured value of the temperature is shown by the position of a green pointer. In general thermocouples are used as detecting elements. Three tolerance bands have been incorporated in the scanning equipment. This enables more important measured variables to give an alarm at, say, 2 per cent deviation. Others may be set to 5 or 10 per cent.

In normal operation up to 50 temperature points will be scanned in sequence. The red pointer will balance to the desired temperature value. The green pointer enables reading of the actual measured value. If the dif-

Fig. 2b. Installation of probing unit for glass level in glass works of Jackson Bros. Ltd., Knottingley, England.

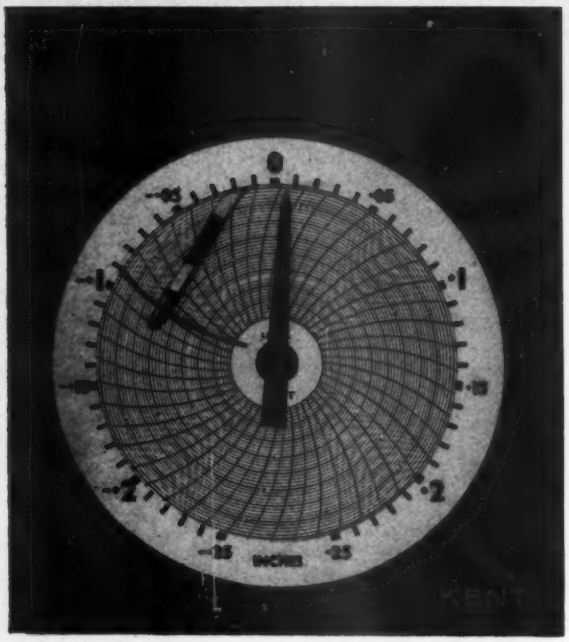


Fig. 3. Electronic recorder-controller for glass level.

ference is more than a pre-fixed amount the scanning switch stops and the signal lamp corresponding to the particular tolerance band will be illuminated. Scanning can be re-started either by bringing the temperature within the desired limit, or by switching scanning by hand to the next point. Scanning speed is about 6 seconds per temperature point.

Cambridge Instruments

The use of Quick-response Féry Telescopes, manufactured by Cambridge Instrument Co. Ltd. of London, England, is widespread in the British glass industry and also in the United States where it is marketed by their associated firm. Féry pyrometers are employed for measuring the temperatures in tank and pot furnaces. They are also widely used in conjunction with automatic regulators.

The Cambridge quick response radiation pyrometer incorporates improvements in electrical and mechanical details. The stem is a heavy 1-inch steel tube, which may be clamped to a pipe, or fixed to a special support. Normally, the rate of response of the instrument is such that 99 per cent of a radiation input corresponding to a full scale reading will be measured in 4.6 seconds, and 99.9 per cent in 6.9 seconds.

Where a still-quicker response is required for exceptional applications at moderate temperatures, a specially fast receiver can be provided to give 99 per cent full scale response in 1.2 seconds, and 99.9 per cent in 1.8 seconds.

A compensating device in the electrical circuit reduces the effect of change in ambient temperature (e. g. about 1 degree low for 1 degree ambient rise at 1650° C and 10 m. v. output). Provision is made for water cooling, however, to ensure accurate readings, and an alarm may be fitted to give warning of failure of the water supply.

The shortest normal distance of operation, measured from the front face of the instrument, is 3 feet, and the size of hot area must not be less than about 1¾ inches for every 3 feet distance. This size is just sufficient to ensure that the image of the hot body when viewed through the telescope and properly focused will completely cover the aperture surrounding the sensitive element.

The instrument is very simple to use and to service. It is sighted upon the hot body by directing the telescope appropriately and viewing through the eyepiece at the rear. The front window it attached by magnets and may be changed in a few seconds, while the mechanical layout is so arranged that any attention required to the mirror or the radiation receiver can be done with minimum interruption of readings. The working design is as follows.

The Telescope

In the Féry Radiation Pyrometer a telescope is focused on the hot body, the heat rays being received on a concave mirror and brought to a focus on a small thermocouple. The electromotive force produced by the consequent heating of the junction of the thermocouple is measured on an indicating or a recording galvanometer calibrated to give direct readings in temperature.

The optical arrangement of the telescope is illustrated in Fig. 7. The heat rays *A* from the furnace are received on the concave mirror *C*, which brings the rays to a focus at *N*. Looking through the eyepiece *E*, the observer sees an image of the furnace in the small mirror *M* and is able to direct and focus the telescope exactly on the required spot. The sensitive thermocouple, situated immediately behind a small hole in the mirror *M*, becomes heated by the rays passing through this hole.

Fig. 4. Portable periscope.

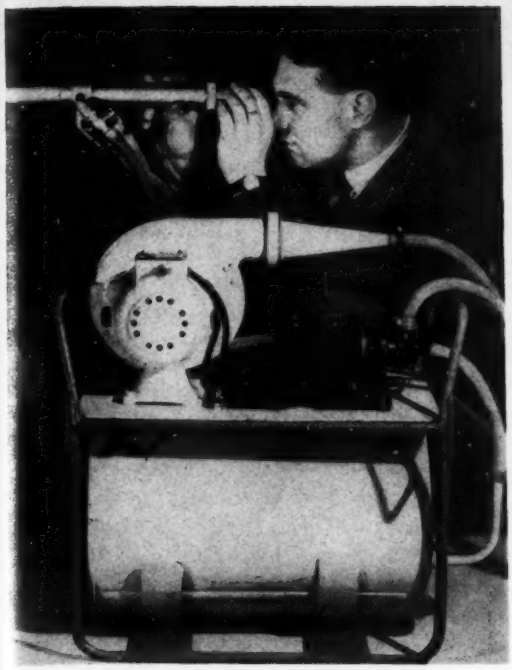


Fig. 4a. Portable periscope equipment.

The mirror *C* is made of rustless steel, which can be polished without scratching, and is practically unbreakable and untarnishable.

Focusing the Telescope

An ingenious device enables the operation of sighting and focusing to be easily and quickly performed. The mirror *M* consists of two small semi-circular, wedge-shaped mirrors fixed together. If the instrument is correctly focused, the appearance is as shown in Fig. 7a, in which the outer circle represents the mirror; the shaded portion, the reflected image of the hot body on which the telescope is sighted; and the black center, the sensitive element of the pyrometer, which must be covered by the image of the hot body.

If the focus is incorrect, the image appears divided into two unaligned parts, the appearance being as in Fig. 7b, when the focus is too short; and as in Fig. 7c, when it is too long.

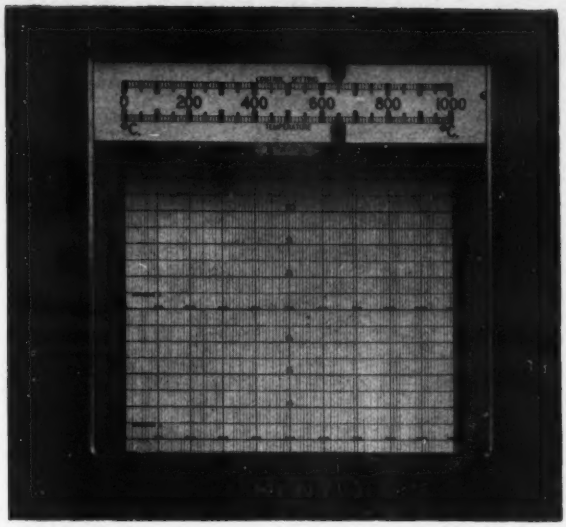


Fig. 5a. Temperature recorder-controller (Multelec type).

By rotating the knurled head attached to the pinion *F*, the upper and lower half images are caused to slide on one another until coincidence is obtained, when the images are in exact focus. This method of focusing is both simple and accurate. The size of the aperture or body sighted on, and the distance of the telescope from it, do not, within wide limits, affect the temperature readings. The body sighted on should be at least 1 inch (25 mm.) in diameter for every 2 feet (60 cm.) of distance between the telescope and the object, to ensure that its image will overlap on all sides the sensitive element in the telescope.

Fig. 7d shows a record obtained on a two-point thread recorder working with two Féry telescopes. Fig. 7e illustrates the Cambridge illuminated indicator used in conjunction with many Cambridge measurement systems.

In this instrument a scale engraved on transparent material is mounted on the moving coil, and a magnified image of a small portion of it is optically projected on

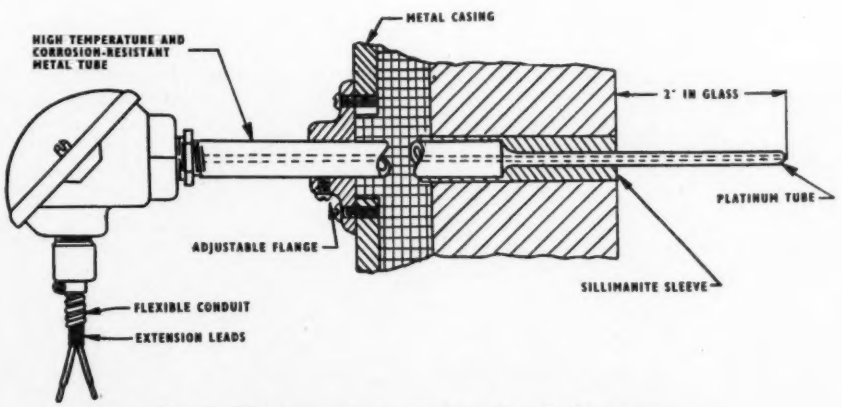


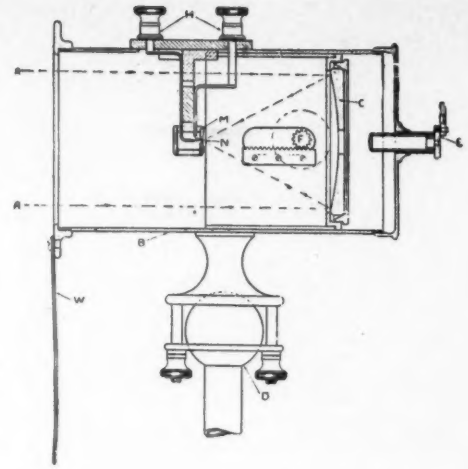
Fig. 5. Thermocouple mounted in glass feeder spout or channel. Sheath is platinum, or platinum-rhodium alloy.

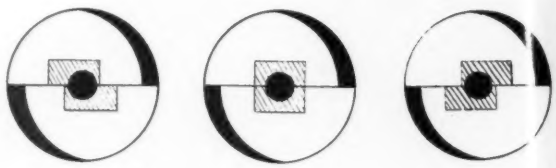
to a translucent screen carrying a fixed pointer. A greatly enlarged scale is thus obtained which is exceptionally clear and easy to read from a considerable distance. If desired, portions of the scale may be stained in different colors to indicate, for example, when the temperature rises or falls beyond certain desired limits. The use of the instrument is not restircted to badly lighted positions, as it gives a clear, well-defined scale under all ordinary lighting conditions.

The large instrument scale is a decided advantage in a glass works for reading temperatures from a distance. The latest addition to recording instruments is the new Cambridge electronic recorder. This versatile instrument incorporates all features which are desirable, such as fast response, high accuracy and lack of instrument time lags.

In glass and pottery manufacture, Cambridge disappearing filament pyrometers, being portable, are frequently employed to read temperatures at a number of points, in addition to the Féry or Thermo-Electric Cambridge recording instruments. Many of these pyrometers are used on glass tank furnaces.

Fig. 6. Temperature scanning equipment.





a b c

Fig. 7. Section through Féry radiation pyrometer. Bottom: a, b, c represent optical section of telescope.

Furnace Instrumentation and Fuel Economy

The glass industry in Great Britain has long been aware that by improving instrumentation of furnaces (Fig. 3) considerable fuel savings can be obtained. The high price of coal, the lack of natural gas, and the necessity to import fuel oil make this tendency for fuel savings understandable in face of keen competition from the European Continent (Fig. 9).

As standard equipment the following instruments are installed for furnace supervision: Pressure gage, draft

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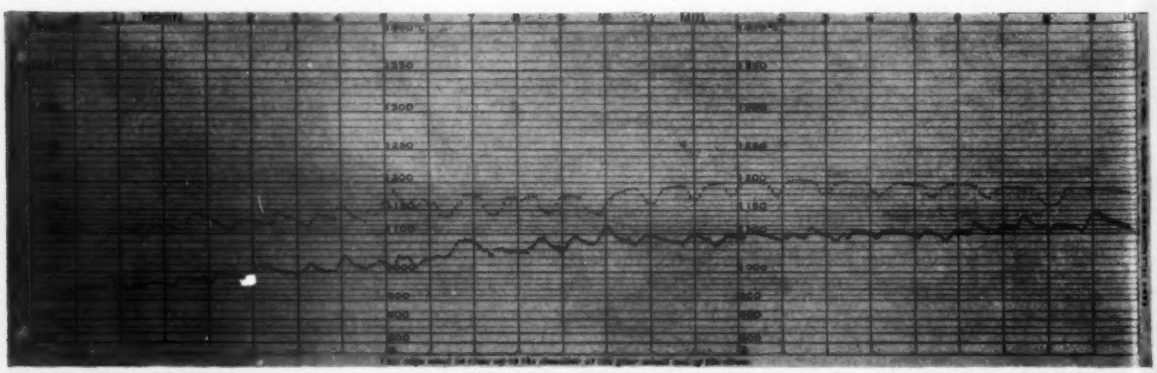


Fig. 7d. Record obtained on a two-point thread recorder (Model B) working in conjunction with two Féry telescopes.

Glass Container Molds

By the Technical Staff
Emhart Manufacturing Company
Hartford, Connecticut

PART THREE: Cleaning and Descaling

• ONE OF THE CONTINUING RESEARCH programs of our company is directed toward improving glass container manufacturing processes. The results being obtained should be of interest to the glass industry, both with respect to current practice and to the realization of future advances.

The first two articles of this series were concerned with the metallurgical structure of cast-iron molds and the relationship of this structure to mold life. This article deals with an investigation that was made of mold cleaning by chemical, electrochemical, and ultrasonic methods.

Cleaning and descaling of molds have long been problems to manufacturers of glass containers. Many of the techniques presently employed involve expensive hand labor and more often than not lead to considerable wear of the molds due to the abrasive materials which are used. As was clearly shown in the first article of this series, molds erode and form scale on their working surfaces at the expense of the metal, so there is a slow change in dimension as wastage occurs.

In cleaning and repolishing, it is therefore important to remove scale only and to avoid the loss of the mold metal as much as possible. Any cleaning method which can do this and which is economical and fast is of considerable importance to glass container manufacturers.

Among cleaning methods that have been used with considerable success in recent years are (1) the Vapor Blast method, (2) chemical methods, using compounds like sodium hydroxide, sodium hydride, salts, and others, and (3) electrolytic cleaning.

In this study, an investigation was made of five different cleaning methods.

a. Chemical cleaning.
b. Electrolytic cleaning in acid solution.
c. Electrolytic cleaning in an alkaline solution.
d. Combined chemical and electrolytic cleaning in alkaline solution.
e. Ultrasonic cleaning.

The molds studied and cleaned were typical, thick-walled cast-iron molds, soiled by oil lubricants in normal use. Both large and small mold parts having varying degrees of embedded scale were used in these tests.

Chemical Cleaning

Chemical cleaning was attempted with a 25 per cent sodium hydroxide solution to which a chelating agent* had been added. The mold parts were immersed in this solution at 90°C for 30 minutes.

It was found that the parts which were lightly soiled and scaled could be perfectly cleaned by this method, but those which were badly fouled could not, since the scale and oil residues formed an impenetrable greasy mass. In the latter case, slightly better results were obtained when the dirty parts were first degreased in benzine or trichlorethylene. Then, after the alkaline bath, the scale could be partially removed by brushing.

Electrolytic Cleaning in Acid Solution

Electrolytic cleaning in acid solution was attempted by using sulfuric acid having a density of 1.106 gms./cm^3 to make a 15 per cent solution. The temperature of the solution was kept at 25°C. The anodes were made of carbon, while the cathodes were made of the parts to be cleaned. A current of 10 amps./dm.^{2} was applied for 3 minutes.

It was found that the parts which were slightly soiled and scaled could be perfectly cleaned by this method, but that the metallic surfaces remained grey and dull. Those parts which had a thick oil-carbon scale could not be cleaned. In an attempt to improve the results, a degreasing technique was tried but was not effective. The concentration of the sulphuric acid solution was then increased to 40 per cent, but there was an obvious deterioration of the mold parts at this strength; moreover, the length of time the parts remained in the solution had to be doubled to obtain the same cleaning effect as with the 15 per cent solution. However, when the parts were first cleaned chemically, as previously described and then cleaned electrolytically for six minutes, it was possible to remove all scale. The metal, however, was left covered with grey spots.

Electrolytic Cleaning in Alkaline Solution

Electrolytic cleaning in an alkaline solution was attempted with a 25 per cent solution of sodium hydroxide at 25°C to which a chelating agent was added. The mold part to be cleaned served as one electrode and carbon as the other. A current of 10 amps./dm.^{2} was then applied for ten minutes, and the polarity was reversed every 25 seconds. During the last reversal, the mold part served as the anode to obtain a brighter surface.

(*Continued on page* 154)

* The importance of chelating agents in industry has been recognized only relatively recently. These compounds, which chemically inactive metal ions, are finding application in such areas as scale removal, metal cleaning, electroplating, and decontamination. In these tests, ethylene diamino-tetra-acetic acid was used as the chelating agent. About 25 gms. of this agent were added to each liter of the 25 per cent sodium hydroxide solution.

Annealing Glass Containers By Radiant Heat

By WILLARD CLARK, Production Engineer
Ball Brothers Company
Muncie, Indiana

• BY CONVERTING TO RADIANT HEATING in lehrs Ball Brothers Company overcame several serious production problems and eliminated the breaking of their glass containers owing to incorrectly applied heating. We also achieved a substantial increase in production rate on glass containers.

The former method of heating employed in the 26 lehrs at Ball Brothers, which are in operation 24 hours a day, involved the use of conventional low-pressure burners located under conveyor belts, and a combustion chamber, positioned approximately 6 feet inside the entrance to blow hot air on the containers as they entered.

Use of a convection heating system with torch-type burners for quality glass annealing, however, necessitated too long a heating zone, which not only reduced production line speed but increased space needs and costs as well.

It required constant attention for changing belt conveyor speeds, temperature controls and adjustment of blower output when shifts from one batch of glass containers to another of a different shape and size were made. And, as indicated above, it was difficult to maintain optimum heat distribution to each glass container, with its different thicknesses, and replace the heat loss of the top of the glass container soon enough as it entered the lehr. This was the cause of the frequent breaking of containers and production losses on imperfections.

Installation of radiant heat roof panels proved the answer. These Duradiant* panels were installed just inside the lehr entrances, where they now answer the most important need of all—replacement of heat to the tops of containers as they enter. Two rows of burners were applied 36 inches back from the entrance, below the belt, in each lehr. The bottoms of containers are in constant contact with the belt and therefore lose less heat. (Fig. 1)

As the entire radiant system is scientifically patterned, more heat is now directed to areas where glass sections are thickest—bottoms and necks of jugs and bottles—so these sections will be heated all the way through at approximately the same time as thinner sections.

Patterned radiant heat applied in this manner, with controlled groups of burners, is also providing the means of raising the temperatures of all containers to the annealing point at a specified cross section in the lehr and thereby stepping up the production rate. Long soaking periods, previously found necessary to raise the overall work temperature to the required level, have been reduced to a minimum.

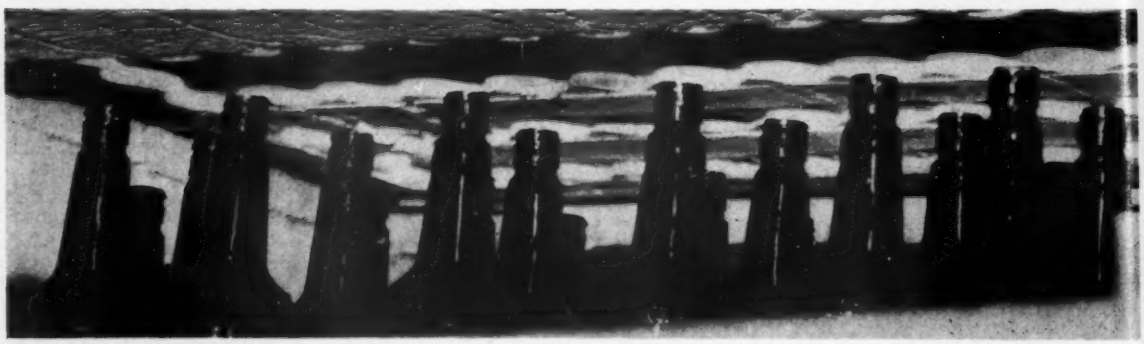


Fig. 1. Interior of lehr showing radiant-heat burners in roof. These burners, and others under the belt, provide accurately patterned heating.

The radiant heat of the burners is created by burning closely controlled gas-air mixtures against special cup-shaped refractory surfaces (Fig. 2). The surfaces, composed of ceramic materials, become incandescent under heat, and they beam radiant heat at the speed of light to glass containers on the 4-foot-wide belt. This high rate of heat transfer, the high temperature gradient attained, and close proximity of the work to the heat source (without any harmful flame impingement) result in faster overall heating operations and stepped-up production.

Runs on lehrs are made with containers usually ranging anywhere from 4-oz. to 128-oz. capacity. With the conventional burner installations formerly used, production of the 128-oz. size was 14 per minute. With the

(*Continued on page* 155)

*Selas Corporation of America

Columbia Southern: New Bartlett Plant

• LATE LAST YEAR Columbia-Southern Chemical Corporation began operating its new multi-million-dollar soda ash and sodium sesquicarbonate plant at Bartlett, California, next to what used to be Owens Lake. This installation has a soda ash capacity three times as great as that of the former Bartlett plant, now being dismantled. A major reason for this expansion is the fast-growing market for natural alkalies on the West Coast among the glass container and chemical manufacturing industries.

Pilot plant work was first carried on at the company's Corpus Christi, Texas, research and development laboratories in order to create a process for producing soda ash of a much higher quality than possible at the old Bartlett plant. In general, Columbia-Southern has made few changes in the basic production principles, but they have added some refinements in their soda ash operation.

The initial step is the withdrawal of brine from the crystal body of the Owens Lake bed by specially designed wells sunk six or seven feet below the dry surface.

Voids in the crystal body of the lake are always filled at this depth with a concentrated brine of sodium carbonate, chloride, sulfate, and metaborate, although their concentrations and relative proportions vary with weather conditions.

The brine is pumped to treating vats or to brine storage tanks, and is then carbonated in towers, under carefully controlled conditions (see cover illustration). This produces a slurry of sodium sesquicarbonate crystals which are decanted from the slurry after it is withdrawn from the towers. The residual mother liquor is returned to the lake.

Some of the sesquicarbonate is dried and marketed as a technical grade of white crystals. The rest of the crystals, along with any bicarbonate that might have been formed in the carbonating towers, is calcined at high temperature to produce soda ash, which, in turn, is refined further by a new method, in order to remove any remaining traces of unwanted materials.

The Owens Lake area has long been known for a rich source of natural salts; in fact, the Owens River used to flow south through a valley under the eastern escarpment of the Sierra Nevadas and drain into a large mountainous area. Many centuries ago, the river waters overflowed into a series of progressively lower basins ending in what is now Death Valley. These basins formed a chain of large lakes, among which was Owens.

As climatic changes gradually altered the balance between precipitation and evaporation, the lakes successively shrank and desiccated, leaving behind accumulations of the soluble salts carried in by the waters that fed them.

Owens Lake is believed to have separated from the rest of the drainage system about 4000 years ago. At one time the waters of the lake are thought to have reached a depth of 250 feet and an area of 240 square miles.

In 1917, the Owens River was diverted into an aqueduct for supplying Los Angeles with fresh water, and the lake finally dried up. Over the centuries natural evaporation has produced the concentrated brine; when the river was diverted, further evaporation caused the large crystal body to develop in the basin, with saturated brine remaining in the voids.

The Lake deposit is estimated to contain over 50 million tons of sodium carbonate, which should be an ample supply for many years to come.

Saturated basin of Owens Lake containing over 58 million tons of natural soda.

Recent Translations of Russian Papers of Interest to the Glass Industry

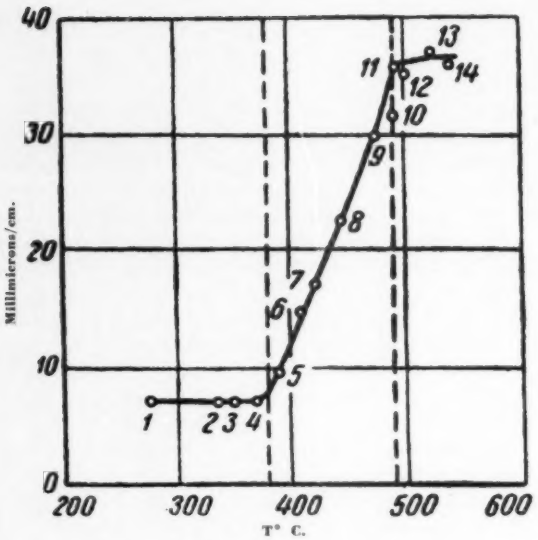


Fig. 1.

The most favorable rate of annealing

L. I. Vidro, M. N. Gorelova and E. I. Velikanova report in *Steklo i Keramika* (Glass and Ceramics) *13*, No. 10, p. 10 (1956), on their success in accelerating the process of annealing parts of radio tubes. These parts previously were cooled to a temperature of 100-120°C within 16 minutes. So many residual stresses remained in them that they had to be additionally annealed in hot ovens, and this stage took 8 hours. When the duration of the first cooling was raised to 25 minutes and the final temperature was raised to 370°C, the residual stresses became so small that no subsequent slow annealing was necessary.

This effect was accounted for by laboratory experiments. Plates, 45x25x6 mm., of a glass whose upper annealing temperature was 440°C were cooled from 550°C at the rate of 9°C per minute. After several minutes, when the glass temperature was T°C, the cooling was accelerated to about 50°C per minute. After the cooling, the residual stresses in the plates were determined optically. Fig. 1 shows these stresses (along the ordinate) as a function of temperature T.

It is seen that, when the slow cooling lasted less than 2 minutes and the rapid cooling started when the glass still had a temperature near 540°C (experiment No. 14), the residual stress was very high. When the temperature T was less than 540° but above 490° (experiments 13, 12 and 11) the stress was almost as great as at T=540°C. It decreased with T between 490° and 380°C, that is 50° to 60°C on both sides of the upper annealing temperature. When the glass was slowly cooled to 370° (experiment 4) or an even lower temperature before the onset of rapid cooling, the stress was small and independent of T. Thus, if glass goods are slowly cooled until their temperature is considerably below the upper annealing temperature, the further cooling can be performed rapidly.

How low the temperature T must be to avoid dangerous stresses, depends for a given glass on the rate of the rapid cooling. Apparently, the difference between the upper annealing temperature and the necessary T is smaller the more rapid the cooling.

Automatic shape cutters

A device which automatically cuts out almost any shape from a glass sheet is described and illustrated by M. I. Levchenko and N. A. Vinogradov in *Steklo i Keramika* (*Glass and Ceramics*) *14*, No. 7, p. 25 (1957).

The glass sheet moves in a horizontal position on a series of rotating rollers. When it reaches a lever and throws it off, electric current is switched on, which (a) stops the rollers, (b) activates an electromagnet which raises a table standing between the rails so that the glass sheet is pressed against the cutter, and (c) causes the cutter to move along a pattern and thus to produce a scratch of the desired shape. As soon as the cutter completes its closed path, the table descends and the rollers resume their movement. The sheet moves to an operator who takes it off the rollers and knocks the shape out of the sheet.

In *Steklo i Keramika 14*, No. 8, p. 22 (1957), a modification of this machine, adapted for cutting circles out of a sheet, is outlined and shown in two figures.

Stresses in cemented glass plates

M. A. Tsaritsyn and G. S. Bogdanova, *Steklo i Keramika* (Glass and Ceramics) *13*, No. 9, p. 15 (1956), studied the causes of the cracking occurring in glass plates used in construction work. These plates are attached to the wall underneath and to each other by cements, and the tensions caused by the setting of the cements are believed to be responsible for the cracking.

The testing procedure was as follows: Plates of 150x70x9 mm. were cut from polished glass. One of the 150x70 and the two 70x9 faces were sandblasted, while the other three faces remained polished. The initial (residual) stresses in the plates were determined optically by looking through from one to the other 150x9 face. Then the plates were placed in cement slurries, and their stresses were measured first daily and then every tenth day.

The plate in the 4:1 mixture of Sorel cement and lignin cracked first (on the 5th day). At this moment, the stress in the plate (expressed as path difference in millimicrons per cm.) was over 300. The next greatest stress (220 millimicrons/cm.) at this time was shown by the plate in the mixture of "expanding cement" 1 part and sand 2 parts; and this plate cracked after 50 days.

The plates placed in (a) Sorel cement 1. lignin 2, (b) Portland cement M-300 1, sand 3, (c) Portland cement 1, sand 2, (d) Portland cement 1, lime 1, sand 6, and (e) Portland cement 1, lime 1, sand 4, had smaller stresses and did not crack at all.

The thermal expansion coefficients of the cements were of no importance; just the two materials (Sorel 4, lignin 1 and "expanding cement" 1, sand 2) which caused cracking had these coefficients (97×10^{-7} and 78×10^{-7}) similar to those of the glass used (90×10^{-7}). Heating of the cemented plates to 100° and cooling to –30° had no effect attributable to the cements.

Thus, the stability of cemented plates can be predicted from the stresses induced in them during the setting of the adhesive.

Glass cutting with a carborundum saw

F. T. Bondarev and I. V. Malevannyi describe in *Steklo i Keramica* (Glass and Ceramics) *13*, No. 8, p. 27 (1956) their experiments with circular saws containing no diamond dust and, consequently, less expensive than the standard tools.

The abrasive material of the new saws consists of residues of abrasive wheels mixed with unused "green silicon carbide No. 60". A "Bakelite Lacquer AB" is used as a binder. The saws are 350-400 mm. in diameter and make 1500 revolutions per minute. The depth of cut varies between 0.25 and 0.3 mm. per revolution. At this rate of work the saw can be used for three to five hours, that is after producing 25,000 to 30,000 sq. cm. of glass fracture. A diamond saw ceases to be usable after 15,000 sq. cm. of glass fracture.

Some chemical processes during glass polishing

They were investigated by A. G. Minakov and T. S. Dubrovskaya, *Steklo i Keramika* (Glass and Ceramics) *13*, No. 9, p. 23 (1956), who analyzed some cakes and efflorescences formed during polishing of two different glasses with crocus suspensions containing zinc sulfate. The most interesting of the substances present in large amounts was sodium sulfate, evidently originating from the sodium silicate in glass and sulfate ion of $ZnSO_4$ and of gypsum used to attach glass sheets to the support.

Dissolution of quartz in silicate melts

This process was observed under a microscope by O. K. Botvinkin and E. M. Shpilkov, *Steklo i Keramika* (Glass and Ceramics) *13*, No. 10, p. 1 (1956).

Quartz sand, having grain diameters between 0.25 and 0.30 mm., was mixed with calcium carbonate and sodium carbonate and heated at 1320°C. After 7 to 40 minutes the pot was cooled and the quartz particles were observed on polished sections. It was found that quartz, starting from the grain surface, was being transformed into metacristoballite (with refractive index 1.49) while tridymite appeared only after 40 minutes heating. The metacristoballite slowly dissolved in the silicate melt. The concentration of SiO_2 next to the grains was 82 per cent, corresponding to the solubility of silica in the silicate melt, and gradually decreased to 74 per cent in 0.06 mm. distance from the grain-melt boundary. The dissolution was accelerated by the gradual disintegration of the grains.

Determination of the Young modulus of glass

A simple instrument capable of determining the modulus of elasticity E with an error of ±1.5 per cent is described by E. F. Pichugin in *Steklo i Keramika* (Glass and Ceramics) *13*, No. 8, p. 10 (1956).

The essential part of the instrument is illustrated in Fig. 1. A glass plate whose E has to be measured is indicated

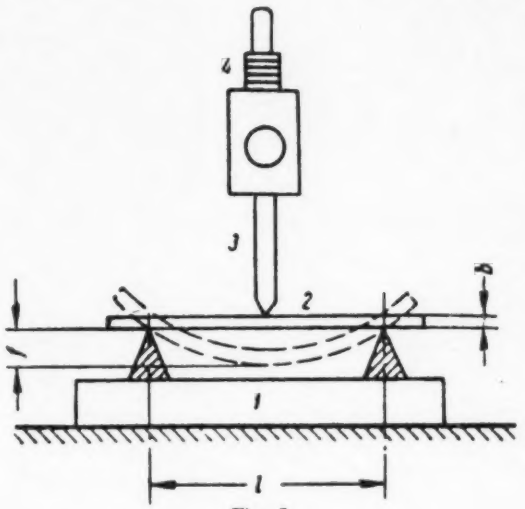


Fig. 1.

by *2*; it is placed horizontally on two hard prisms (borrowed e.g., from an analytical balance). The prisms rest on block *1*. A plate *3* whose lower end forms a wedge (perpendicular to the plane of paper) is lowered until it touches the glass, and the position of the upper end is viewed in a microscope with an eyepiece micrometer; the length of the wedge is equal to the width of the glass plate. Then weights *4* are placed as shown in the figure to load the wedge. The glass plate bends as indicated by the dashes. The new position of the upper end of the vertical plate is recorded. If f is the distance between the two position, P the load, l the distance between the two prisms, h the width of the glass plate (and the length of the wedge), and b the thickness of the glass, then

$$E = \frac{Pl^3}{4hb^2f}$$

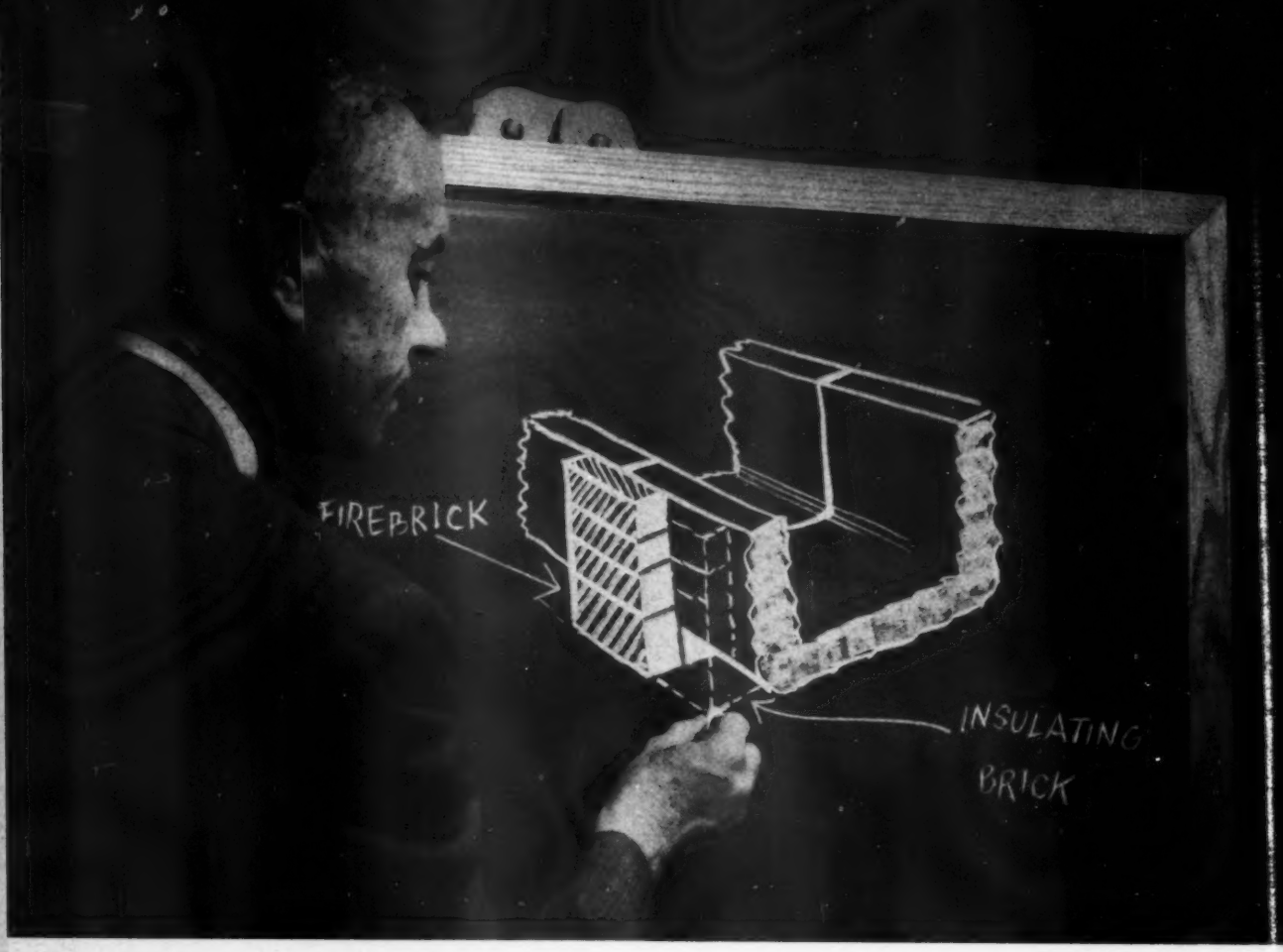
In Pichugin's experiments, P varied between 1 and 3 kilograms, l was 130 mm., $h=7$ mm., b varied between 0.20 and 2.75 mm. and f was 0.02 to 2.0 mm.

Accelerated cooling of sheet glass

S. G. Lioznyanskaya, V. I. Kostin and P. V. Voronin report in *Steklo i Keramika* (Glass and Ceramics) *13*, No. 11, p. 9 (1956), on the successful attempt to accelerate the cooling of sheet glass during its withdrawal, carried out in the Lvov Glass Works.

The sheets are pulled upward by 12 pairs of rollers. Their temperature at the upper end of the shaft was above 300°C when the sheet was 2.8 mm. thick and the rate of withdrawal was 87 meters/hour. This high tem-

(*Continued on page* 150)



Engineering hints from Carborundum

How to avoid problems at feeder-channel joints

Using firebrick in place of insulating brick at feeder-channel bottom and side joints helps avoid erosion of back-up lining resulting from glass seepage. The much stronger and more resistant firebrick give better bottom support to individual blocks. This type brick also lessens possible contamination by insulating material used normally.

A ¼" thick layer of ALFRAX® aluminum oxide cement troweled on the bottom insulation, provides a hard, corrosion-resistant facing between it and the channel. This facing also furnishes a level base for the channel blocks.

Wide experience with particularly troublesome spots, like these, often enables Carborundum to supply answers to a broad range of refractory problems. Moreover, MONOFRAX® fused-cast refractories are made in *four* distinct types to meet the specific needs of *every* critical area in all types of glass tanks.

MONOFRAX S refractory is a general-purpose tank material that offers unequalled resistance to erosion and corrosion and exceptional thermal shock resistance for complete melting ends and other vulnerable areas, both above and below the metal line. MONOFRAX M refractory, with high purity, is recommended for entire refining ends and channels. MONOFRAX H refractory is widely used in the superstructure because of low glassy phase and ability to resist heat shock. MONOFRAX K refractory is offered for special applications, particularly in fiber glass tanks.

Since no two tanks operate alike, top performance comes from "engineering" refractories to specific service needs. Carborundum has the experience—*and the special-purpose refractories* to help you get quality glass at the lowest possible refractory cost. For recommendations, contact Department L-39, Refractories Division, Perth Amboy, New Jersey.

CARBORUNDUM

Registered Trade Mark

CORNING EXPANDING PYROCERAM

Corning Glass Works is completing plans to lease tempo-arily kiln facilities at Paden City, West Virginia, (Paden City Pottery Company) for additional capacity for finishing Corning Ware.

The company's Pyroceram products are being introduced regionally and have been offered for sale in only one-half of the country. When the ware produced at the Main Plant is in excess of local kiln capacity, it will be shipped to Paden City where it will be decorated, cerammed, packed and shipped to distributors.

CARLISLE IN PPG EXECUTIVE POST

Maurice E. Carlisle has been appointed assistant to the vice president, glass division, of Pittsburgh Plate Glass Company. He had previously been assistant to the director of engineering for the glass division during the past year.

Maurice E. Carlisle

Having joined the company in 1929 as a draftsman in the Pittsburgh office, he became associated with the glass division in 1938 as assistant purchasing agent. Mr. Carlisle was appointed general purchasing agent in 1942 and since that time has also served as manager of construction and purchasing for the company's glass division.

PPG EMPLOYEES RETURN TO WORK

The employees of Pittsburgh Plate Glass Company voted on February 16 to accept a memorandum of agreement and end the 134-day walkout at nine plants. All seven locals involved in the labor dispute, according to officials of the United Glass and Ceramic Workers Union, had voted to return to work.

ANNUAL A. C. S. MEETING

The Glass division of the American Ceramic Society is planning a full day's symposium at the 61st annual meeting to be held from May 17 to May 21, Palmer House, in Chicago. Entitled, "Behavior of Glass in the Visco-Elastic Range," the symposium will be presided over by Howard R. Lillie.

Program committee members are Ralph K. Day, chairman; R. D. Maurer, and C. L. Babcock.

The Basic Science Division program will be guided by Dr. R. F. Walker, National Bureau of Standards, according to Dr. Howard McMurdie, division chairman. Dr. Walker is taking the place of the late Dr. Samuel Zerfoss who died on December 19.

Two honorary members will be named to the Society at the general session on Monday morning, May 18, and twenty-four members will be elevated to Fellows of the American Ceramic Society by action of the Board of Trustees.

Complete details of the Annual Meeting, and a full program, will be included in the April issue.

O-I METALLURGICAL RESEARCH

The general research department of Owens-Illinois Glass Company has established a section to handle metallurgical research and services.

Ray S. Richards, research metallurgist since 1957, will head the section. Neil M. Waterbury, chief metallurgist for the company's glass container division, will continue to concentrate on glass container problems, having had more than 25 years of experience in this work.

Ray S. Richards

Neil M. Waterbury

Others in the section are O. M. Small, Sigmund Willinger, John P. McGowan, Charles W. Rhoades, Robert W. Havens, and Virgil F. Ancell. They were formerly all members of the glass container engineering department.

The company hopes, stated James W. Hackett, director of research, that the new section will be able to devote more time to the development of new ideas in addition to solving present problems.

INT. MINERALS FELDSPAR MILL

International Minerals & Chemical Corporation has put into operation a new feldspar mill near Custer, South Dakota. This replaces the mill destroyed by fire last July. It includes five 54-foot silos, each with 500-ton capacity for refined feldspar storage, and two smaller ore storage silos.

Ralph H. Brigham, in charge of the original plant, will continue as plant manager.

MOUNT JOINS VITRO LABS.

Dr. Lloyd G. Mount has been named head of the chemical research and development department of Vitro Laboratories, West Orange, N.J. He has been active in chemical research for 19 years.

DURHOLT RETIRES, OWENS-ILLINOIS

Harry J. Durholt, vice president of Owens-Illinois Glass Company and general manager of the Libbey Glass Division, retired last month. He entered the glass manufacturing field in 1918 as a machinist at the North Toledo plant of Libbey Glass. During his 40-year career, he participated in many glass machinery developments which helped make possible the mass production methods now used in the manufacture of table glassware.

He has been associated with the Owens-Illinois administrative division for the past three years.

CORNING CASTS 84-INCH DISK

Corning Glass Works is now annealing an 84-inch disk which will become the primary reflective piece in one of two telescopes being constructed as part of a new national observatory at the top of Kitt Peak, near Tucson, Arizona. The annealng operation will take 7 months, after which the disk will be ready for shipment, probably during the summer. At Tucson, the mirror will be ground and polished and then transported to the top of the 6,785-foot peak.

Engineers at Corning based their six months of planning on the previous work done on the 200-inch disk by Dr. George V. McCauley 25 years ago. In order to

Placing ceramic core in position prior to melting the glass for 84-inch telescope mirror blank being manufactured at Corning Glass Works for a national observatory now under construction near Tucson, Arizona.

make a ribbed pattern, cores of ceramic brick were placed in precise positions according to a pre-determined plan. This imparted the greatest strength and rigidity possible to the disk, and it also kept the weight down.

This is the first large-size glass disk of ribbed construction to be made by the sagging method, the 200-

The 2,796-pound piece of glass has been placed on center core of mold, with smaller pieces of glass in position around it.

inch mirror having been formed by ladling molten glass into the mold.

First, the cores were both cemented and bolted to the floor of the mold; a cooling system on the underside of the mold prevented the steel rods, which anchored the cores, from melting under the furnace heat. Triangular and kidney-shaped cores are to give the mirror the greatest support; cylindrical cores will form the points where the mirror will be held in position in the telescope; and the center core will form the 26-inch central hole of the mirror.

In the sagging method the 2,796-pound jagged piece of glass, after being scrubbed by sandblasting, was placed on top of the circular mold in the center. Smaller pieces of glass were placed around it, each one having been selected according to its weight and shape.

The glass was then successfully melted down at approximately 2300°F. The reason for using the sagging method was to reduce bubble inclusions and cut the cost. Also, this was a less complicated procedure than the ladling method.

Melting of the glass was completed by gas heat which entered the top of the furnace through jets—and by electrical heat supplied through elements lining the underside of the mold.

In the annealer the disk is being heated by electricity, with elements lining the interior of the circular skin. The temperature will be constant for two months and then slowly cooled at about one degree (centigrade) a day.

The national observatory, for which this mirror is being constructed, will be operated by the Association of Universities for Research in Astronomy, Inc. It is being constructed under the sponsorship of the National Science Foundation.

M.I.T. LECTURES ON ADHESIVE JOINTS

The Massachusetts Institute of Technology will give an intensive course on adhesive joints from June 29 to July 3, consisting of two sessions daily of 3 hours each. Lecturers will include A. G. H. Dietz, F. J. McGarry, J. J. Bikerman and W. G. Moffatt from M.I.T.; C. Mylonas from Brown University; and W. K. Asbeck, S. Twiss and F. Wetzel as representatives of industry.

Among the topics to be discussed will be solid surfaces, wetting, application of adhesives, tackiness, setting, testing of joints, stress concentration in joints, plastic and elastic adhesives, final strength and bulk strength, and the rheology of peeling and scraping.

Because attendance is limited to 30 persons, applications should be submitted as soon as possible to the Office of Summer Session, M.I.T., Cambridge 39, Mass.

THIRD O-I PLANT IN LATIN AMER.

Owens-Illinois Glass Company's third Latin American glass container plant will begin operations in Bogota, Colombia, this year. The company has exercised its option to buy the physical assets of Vidrio S. A., a firm in Colombia which closed down last year.

J. P. Levis, chairman of the board, states that Owens-Illinois will start glass container production as soon as the furnace is rebuilt and new machinery and equipment from the U. S. is installed.

Other Owens-Illinois plants in Latin America include those in Havana, Cuba, and Valencia, Venezuela. Plans for the Colombian plant include possible future expansion into other products, including table glassware.

This plant will have five forming machines and five annealing lehrs for bottles and jars in a wide variety of sizes. Some 200 Colombians will be employed when the plant opens; technicians from Owens-Illinois plants in the United States will train them.

About 97 per cent of the raw materials needed will be available in Colombia.

RADIATION-SHIELDING WINDOWS

Pittsburgh Plate Glass Company will build 31 radiation-shielding windows, each five feet thick, for the Atomic Energy Commission under an order placed by the Argonne National Laboratory, operated by the University of Chicago. The windows will be used in the Atomic Energy Commission's new testing facility at Arco, Idaho and will be incorporated in a new doughnut-shaped process building which will house a pyrometallurgical laboratory for testing atomic fuels.

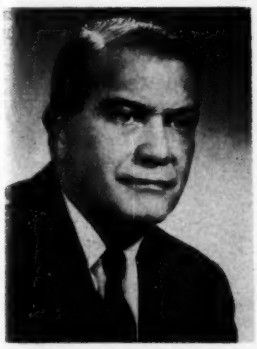
Each of the windows will contain three plates of glass one inch thick, with the total glass weight per window being 6,000 pounds.

A new hour-glass shape will be incorporated in the design of the windows for retaining the maximum vision and at the same time reducing the amount of glass required for the three-foot square viewing area of each window.

All activity in the large shielded cell at the new Arco facility will be viewed through the 31 windows, permitting observation of the experiments and fuel element fabrication within the fast breeder reactor.

NAMED BY J-M FIBER GLASS

Thomas A. Collins has been named vice president in charge of operations planning of Johns Manville Fiber Glass Inc. This department will be responsible for developing combination products which will use asbestos, fiber glass and other materials.



Thomas A. Collins

Having spent his entire business career in the glass field, Mr. Collins was formerly vice president of L-O-F Glass Fibers and, prior to that, executive vice president of Glass Fibers Inc., both predecessor companies of Johns-Manville Fiber Glass. Before that he had been with Owens-Illinois Glass Co. for twenty-six years.

INFRARED DOME

Servo Corporation of America has manufactured a hemisphere-shaped arsenic trisulfide infrared dome measuring 12 inches in diameter. Said to be the largest dome made in one piece, it has been delivered under contract to the U. S. Naval Air Development Center, Johnsville, Penna., and will be used on an experimental test vehicle designed to make comparative ground and airborne studies of the detection capabilities of infrared equipment using various detectors.

Initial studies will be performed on the ground using fly-over targets. Depending on the results of these tests, the equipment will then be installed in a nacelle hung on a high-performance aircraft and flown at high altitudes.

The dome, according to Servo, is made of glass which is very stable, does not deteriorate with use, and is non-hygroscopic and non-photosensitive. It will retain its shape without undergoing plastic deformation under pressure.

BLEININGER AWARD TO GELLER

Rome F. Geller

Rome F. Geller, chief of the Porcelain and Pottery Section of the National Bureau of Standards until his retirement in 1956, will receive the Albert Victor Bleininger Award on March 13. Presented annually by the Pittsburgh Section of the American Ceramic Society, this award is the highest honor conferred in this country for distinguished achievement in the field of ceramics.

He joined the Bureau staff in 1918 as a ceramic technologist in the Pittsburgh laboratory and served as chief of the N.B.S. Refractories Section from 1925 to 1927 when he left to become director of research for the Abrasive Co. in Philadelphia.

In 1930 Mr. Geller returned to the Bureau as chief of the Porcelain and Pottery Section and, although retired, continued to serve the NBS Mineral Products Division on a part-time basis as chairman of its editorial committee, and as a ceramic consultant.

Mr. Geller received his B.S. degree in chemical engineering from the University of Michigan in 1918 and during the years has published 65 papers in the refractories and whitewares fields. He also holds a patent for a thoria resistor heating element.

Having served as chairmam of both the Refractories and White Wares Divisions, he is a Fellow of the American Ceramic Society and has been a member since 1919. He is also a member of the National Institute of Ceramic Engineers, the American Society for Testing Materials, and the Washington Academy of Sciences—and a Fellow of the American Association for the Advancement of Science.

He has served as chairman of the Sectional Committee B7 on Abrasive Wheel Safety Codes of the American Standards Association; sub-chairman of the Federal Specifications Board Technical Committee on Abrasives, Polishing Materials, and Potter; and secretary of Committee C21 on Ceramic Whitewares of the American Society for Testing Materials.

ST. GOBAIN DISTRIBUTION IN U.S.

American-Saint Gobain Corporation has assumed the exclusive distribution in the United States of plate glass products manufactured by Saint-Gobain in its factories at Chantereine, France; Franiere, Belgium; and Stolberg and Herzogenrath, West Germany.

H-W NAMES RESEARCH EXECUTIVES

Donald F. Stock has become manager of the Garber Research Center of Harbison-Walker Refractories Company. He joined the company in 1949 as research engineer, until 1953, when he was named manager of Hays Laboratory at Pittsburgh.

Donald F. King is assistant manager of the research center. He has been with Harbison-Walker since 1941 when he joined as a research chemist.

L-O-F FURNACE ENGINEERS PROMOTED

Millen E. Luhrs has been appointed senior project engineer, in charge of the design and construction section of the furnace department, engineering division, Libbey-Owens-Ford Glass Company.

Millen E. Luhrs

John W. Herbert

John W. Herbert has become senior project engineer as head of the ceramic and improvement section.

John H. Hansen, formerly chief engineer in the furnace department, has relinquished his duties because of health.

INTERNATIONAL CONGRESS ON GLASS

A preliminary agenda has been announced for the Fifth International Congress on Glass to be held in Munich from June 29 to July 4. The technical sessions will include:

a. Contributions to control of glass quality.
b. Investigation of glass melting and forming processes.
c. Mechanical properties and behavior of glass.
d. Refractory corrosion and currents in glass melting furnaces.
e. Physics and chemistry of glass.
f. Structure of glass.
g. Infrared transmission of glass.

During the Congress there will be an exhibition of photographs on the subject of "Glass in Pictures," emphasizing the following themes:

a. Photographs of glassworking and glassmaking.
b. Photographs of glassware.
c. Photographs illustrating architectural or other applications of glass.

The most effective photographs will be shown during the Congress; prizes will be awarded. For further information, contact: Deutsch Glastechnische Gesellschaft, 126, Bockenheimer Landstrasse, Frankfurt (Main), Germany.

Up to the present time, 45 papers have been received for delivery at the Congress. Countries so far represented include the United States (12 papers), England (10), Germany (10), France (6), Belgium (6), Holland (5), Italy (4) and Russia (2). One paper each has been received from India, Japan, Sweden, Egypt, Switzerland, and Austria.

These technical papers will be printed and distributed to all participants before the Congress. They will be published after the Congress in a special volume of the "Glastechnische Berichte," which will be offered for sale.

More details on the Congress volume will appear in THE GLASS INDUSTRY later in the year. It is expected to be published in November and will contain all papers as they have been read at the Congress. In addition, there will be a summary of each manuscript in German, English and French.

Financial Reviews

FOOTE MINERAL COMPANY

Foote Mineral Company sales in 1958 ($24,553,651) declined 1.4 per cent from the $24,895,561 in 1957. Sales in the last quarter of 1958, however, were highest in the company's history. Net earnings in 1958: $2,144,362; in 1957: $2,302,224.

KNOX GLASS, INC.

Knox Glass, Inc., has reported a 7 per cent increase in sales in the first fiscal 1959 quarter ($9,130,810) ended December 31, over the same period last year ($8,494,710).

SYLVANIA—GEN. TELEPHONE MERGER

Stockholders of Sylvania Electric Products, Inc., and the General Telephone Corporation last month approved a merger of Sylvania into the latter company, under the name of General Telephone and Electronics Corporation.

Donald C. Power, president of General Telephone, will become chairman and chief executive officer of the combined organization with assets of more than $1,800,000,000.

Don G. Mitchell, now president and chairman of Sylvania, will be president of the new company.

Sylvania, a leading manufacturer of television sets and tubes, lighting products, and various industrial electronic items, has 45 manufacturing plants and 22 research laboratories in thirteen states.

Gross operating revenue of the combined company is expected to exceed $1 billion this year; last year's combined total of the two companies was $900 million.

OWENS-ILLINOIS GLASS COMPANY

Annual sales, 1958, dropped slightly; earnings were up as a result of non-recurring income. Owens-Illinois sales last year were $508,459,930, or 0.5 per cent less than 1957 ($510,486,850). The slight sales decline resulted from the sale of Kaylo.

After preferred dividend requirements, $4.82 was earned per share of common in 1958; $4.55 in 1957.

MEXICO REF. & KAISER DISCUSS MERGER

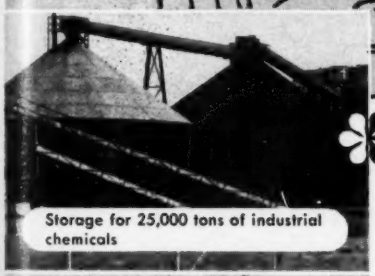
Kaiser Aluminum & Chemical Corp. and Mexico Refractories Co. were discussing the possibility of a merger, last month. No further developments have been announced. They would combine their refractories operations.

The 1958 sales of Mexico Refractories, which have not been released, were estimated at $16.5 million, compared with $20.9 million for 1957, according to W. Basil Leach, president.

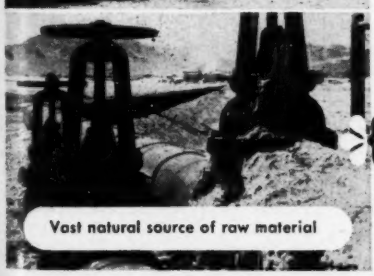
Mexico Refractories has plants in Mexico, Mo.; Van Dyke, Penna.; Frostburg, Md.; Niles, Ohio; and Bronte, Ontario.

West End "fills the order"...

TO PLANT 9/11 2:35 P M
HAZCO URGENTLY NEEDS EXTRA
HOPPER CAR SODA ASH FROM TANK
6 SHIPPED TODAY. ADVISE. END
TO OFFICE
CAN DO. WILL PULL CAR FROM
STORAGE SPUR AND SHIP TODAY.
CAR NO. NAHX 31078.


Storage for 25,000 tons of industrial chemicals

Immediate shipment in leased hopper cars


Vast natural source of raw material

Meeting service requirements to the letter and producing superior soda ash of consistently accurate particle size and chemical analysis are the essentials to which the West End organization is uniquely geared. A system of rapid communications linking our sales office in Oakland with our production, technical and shipping departments at the desert plant site permits each department head to have a complete understanding of the customer's individual requirements and to make firm commitments or provide the desired information promptly.

WEST END SODA ASH

WEST END CHEMICAL COMPANY

EXECUTIVE OFFICES, 1956 WEBSTER, OAKLAND 12, CALIF. • PLANT, WESTEND, CALIF.

DIVISION OF Stauffer CHEMICAL COMPANY

Inventions and Inventors

Annealing and Tempering

Glass tempering apparatus. Patent No. 2,855,727. Filed April 29, 1955. Issued October 14, 1958. No sheets of drawings; none reproduced. Assigned to Pittsburgh Plate Glass Company by Lloyd C. Kerkoski.

The present invention relates to novel improvements in glass tempering apparatus, and particularly concerns the installation of warning devices to insure that the tempering fluid is applied to glass at the proper pressure.

Whenever any portion of the pressure system for either the high- or the low-pressure air boxes falls below the minimum pressure deemed critical for that portion of the tempering system, the pressure in one of the outlet sampler pipes drops. One of the diaphragm relay switches closes in response to the reduced pressure, thus causing the relay to actuate the common alarm circuit, thereby sounding the horn and lighting the light. Immediately upon hearing the horn or seeing the light flashing, personnel tending the apparatus observe the readings on the pen recorders to determine which sampler pipe is sampling an insufficient pressure. Four-way valves are aligned with each pipe in sequence, and the manometers are observed to verify the pen recorder readings. Once a portion of the system is shown to be defective, the area of search for the defect is localized, and the tempering oscillator can be repaired much more rapidly than if no indication of a leak location is given.

Also, by virtue of the immediate sounding of the horn and the lighting of the light in response to a failure in the system, the tempering operation may be stopped immediately until such time as the defect is corrected. Therefore, incomplete tempering between the time of the occurrence of a defect and the time the production lights are determined to be improperly tempered is eliminated. Therefore, according to the present invention there is less necessity for repeating the tempering process for those sheets which are inadvertently tempered improperly, and any repairs in the tempering apparatus can be accomplished relatively quickly.

There were 2 claims and the following references cited in this patent.

United States Patents

2,199,511, Perry et al., May 7, 1940; 2,493,548, Proctor, Jan. 3, 1950; and 2,608,029, Glynn, Aug. 26, 1952.

Apparatus for glass tempering. Patent No. 2,841,925. Filed February 8, 1954. Issued July 8, 1958. No sheets of drawings; none reproduced. Assigned to Permaglass Inc. by Harold A. McMaster.

The invention relates to apparatus for tempering glass.

An object of the invention is to provide improved apparatus in which frames carrying glass plates or sheets may be continually passed through a furnace provided with means for uniformly heating the opposite sides of the plates or sheets to substantially the softening point of the glass. The glass plates or sheets are then quickly passed into a blast head without drawing heated air from the furnace and jets of air are impinged at a comparatively high speed against the opposite sides of the glass plates. The movement of the air is then quickly reversed and removed from the blast head to provide sudden cooling of the glass plates or sheets.

The improved apparatus includes a furnace and blast head, each having front and rear doors in which a partial vacuum is maintained in the blast head when the doors of the blast head are closed. This partial vacuum is automatically destroyed when the doors of the furnace and blast head are opened, permitting frames carrying glass plates to be passed into the blast head without drawing heated air from the furnace, or cold air into the blast head.

There were 7 claims and 17 references cited in this patent.

Feeding and Forming

Method of sealing together thick-walled hollow glass parts. Patent No. 2,821,812. Filed April 14, 1954. Issued February 4, 1958. No sheets of drawings; none reproduced. Assigned to North American Philips Company, Inc., by Henricus Gerbrand Pieter Vermaas and Otto Louis Van Steenis.

This invention relates to a method of sealing together thick-walled hollow glass articles, especially the glass window and cone of a cathode-ray tube.

Poor seals leading to rejects are at a maximum during the first half of the preheating periods, because the glass parts, more particularly the cone and the window of a cathode-ray tube, are very liable to cracking during said period.

This is ascribed to poor thermal conduction of the glass in the cold state while at comparatively low temperatures the thermal spreading in the glass due to thermal radiation is insignificant. At the beginning of the preheating period a considerable temperature gradient occurs from the outside to the inside in the wall, thus creating high stresses in the glass. When the glass becomes hotter said gradient decreases, since the thermal radiation in the glass is reflected and absorbed, so that the thermal conduction apparently increases.

This inconvenience can be obviated almost entirely if in a method of sealing together thick-walled hollow glass parts, while preheating said parts which are slightly spaced apart, a heating element is inserted for some time between said edges during the preheating operation and after removing the heating element, the edges are subsequently further heated and sealed together.

It is, in general, sufficient to hold the heating element for some time, about half the length of the preheating period, between the edges to be sealed. Said heating element may be a glow or infra-red heating plate or a flat frame on which heating spirals are stretched. Since the glass parts usually rotate during the heating operation, the heating element need not be as large as said glass parts but may, if desired, consist of one or more rods

that are maintained between the rotating edges. Owing to the heat from this heating element, the glass sealing edges and part of the remaining wall of the glass parts are internally heated more rapidly. As a result, the temperature gradient greatly decreases from the outside to the inside.

This is of particular importance during the first part of the preheating period when the temperature of the glass wall externally increases from room or ambient temperature to 350 degrees centigrade. At higher temperatures the absorption of the thermal radiation is such that the wall is also internally heated sufficiently.

There were 2 claims and the following references cited in this patent.

United States Patents

2,034,925, Slayter et al., Mar. 24, 1936; 2,191,953, Blau, Feb. 27, 1940; 2,261,011, Wiley, Oct. 28, 1941.

Foreign Patents

536,858, Great Britain, May 29, 1941.

Means for directing charges of molten glass into molds. Patent No. 2,810,236. Filed September 3, 1954. Issued October 22, 1957. Two sheets of drawings; none reproduced. Assigned to Owens-Illinois Glass Company by Eustace H. Mumford.

The invention relates to apparatus for directing mold charges or gobs of molten glass, as they are discharged from a feeder, into forming molds. In the glass art it is customary to direct molten charges from a feeder downwardly through an inclined chute by gravity, which extends over the open end of the mold.

It provides a novel apparatus comprising a deflector by which the charges are accurately directed into the mold cavity. The deflector extends into the open mold cavity for positively controlling and directing the mold charge. Automatic means are provided for withdrawing the deflector and permitting the mold, neck ring and mold plunger to be brought into cooperative relation. In the illustrated form of the invention the blank mold, neck ring and plunger are brought together by an upward movement of the mold and downward movement of the plunger. A link connection between the deflector and the blank mold operates to withdraw the deflector as the mold is moved upward.

There were 14 claims and the following references cited in this patent.

United States Patents

1,314,691, Netter, Sept. 2, 1919; 1,982,103, Hiller, Nov. 27, 1934; 2,165,985, Schwentler, July 11, 1939; and 2,267,236, Goodrich, Dec. 23, 1941.

Apparatus for shaping glass tubes. Patent No. 2,811,813. Filed May 27, 1954. Issued November 5, 1957. Three sheets of drawings; none reproduced. Assigned to Western Electric Company, Inc., by Christian Paulson.

This invention relates to an apparatus for shaping glass tubes.

An object of the invention is to provide an improved apparatus for forming a glass envelope having portions thereof of different diameters with uniform wall thickness.

Certain features of the invention include a chuck for supporting a glass tube for rotation about its axis, means for rotating the chuck and the tube, and means for heating the portion of the tube which is to be shaped. A composite arbor having a plurality of annular forming rollers freely mounted for rotation relative to each other about a common axis and having outer peripheries of predetermined configuration engageable with the inner periphery of the glass tube is supported for movement axially into the tube. It is movable transversely of the axis into engagement with the glass tube to deform portions thereof, and a plurality of hollow-forming rollers engageable with the outer periphery of the glass tube are mounted for movement individually into predetermined operative positions in engagement with the glass tube for cooperation with the annular sections of said composite arbor to form the glass tube into a predetermined shape while maintaining substantially uniform wall thicknesses therein.

There were 7 claims and the following references cited in this patent.

United States Patents

537,429, Alexander, Apr. 16, 1895; 1,528,392, Baehr, Mar. 3, 1925; 1,728,286, Hoagland, Sept. 17, 1929; 2,266,417, Eisler, Dec. 16, 1941; 2,284,089, Hahn et al., May 26, 1942; and 2,312,225, Wilkinson, Feb. 23, 1943.

Furnaces

Furnaces. Patent No. 2,834,306. Filed January 14, 1953. Issued May 13, 1958. No sheets of drawings; none reproduced. Assigned to Pilkington Bros. Ltd., by William Bryson Roxburgh.

During heating or cooling of a glass furnace, the roof bricks undergo changes according to the temperature they attain, and as the inner face of the roof may attain a temperature of 1500°C. while the outer face may not reach more than about 300°C., the roof bricks become divided into zones having different characteristics of thermal expansion and contraction. Consequently, there is a tendency for the bricks to crack at some level in the thickness of the roof with the result that a piece of brick may drop out and fall into the tank.

In the present invention there is provided a glass-making furnace structure comprising a floating arched roof rested on springers and covering a melting tank. A series of elements erected alongside of the roof and tank function to support the weight of the roof. The roof-supporting structure comprises springer supports in the form of angle brackets suspendable from said elements for tilting movement about axes extending lengthwise of the roof and for movement towards and away from said elements.

Axially adjustable rigid thrust-reaction members engage the springer supports and act as fulcrums to support the reaction members with their axes in a horizontal plane intersecting the abutting faces of the springers and the sides of the roof. Means are provided to connect the bearings to said elements for adjustment lengthwise thereby to permit selection of the positions of engagement of the thrust-reaction members with the springer supports and means for effecting axial adjustment of the reaction members to restrict reaction thrust

(*Continued on page* 162)

Research Digest

Thermodynamics of Arsenic in Glass

• ARSENIC IN THE FORM of arsenic trioxide is used extensively in the manufacture of glass. It is added in small quantities for two purposes: (1) to aid the fining process and (2) to decolorize the glass. The fining action of arsenic trioxide, usually together with saltpeter, is not quite clearly understood and its usefulness has even been doubted, but as a decolorizer it has proved its value. The latter action is due to the fact that arsenic in glass can exist in two valence states, As^{5+} and As^{3+}, and thus forms a redox system; i. e., it can accept and donate electrons. In the presence of iron in the molten glass, it becomes an electron acceptor; in other words, the iron is oxidized.

$$As^{5+} \; 2Fe^{2+} = As^{3+} \; 2Fe^{3+}$$

Another example of arsenic as a decolorizer is its effect on selenium in glass.

It has been pointed out that the loss by vaporization of arsenic is considerably diminished by the addition of an oxidizing agent, as saltpeter, from which it can be concluded that the pentavalent oxidation state in glass is more stable than the trivalent. Arsenic trioxide also has been identified in the vapor phase above molten glass, and crystals of arsenic trioxide have been found in seeds in the cooled glass. A means to diminish the loss by vaporization is to add the arsenic in the form of a compound, e. g. calcium arsenate, where arsenic is already in the pentavalent state. Cullets containing arsenic, which is mostly in pentavalent form, also can be used.

Here it must be pointed out that the arsenic pentoxide dissociates at elevated temperatures into arsenic trioxide and oxygen; in other words, under those conditions the arsenic trioxide is more stable. To compensate for this instability one can conclude that the numerical value of the free energy of solution of As_2O_5 in glass must be large.

In connection with this discussion it is of interest to compare the reactions of arsenic oxides with basic oxides, for instance MgO. Below 800° C. arsenic trioxide and magnesium oxide form magnesium arsenite, which above this temperature is converted into arsenate and elementary arsenic. Expressed in oxide form the latter reaction is

$$5As_2O_3 = 3As_2O_5 + As_4$$

At still higher temperature (1100° C.) the arsenate starts to decompose in the following steps:

$$Mg(AsO_3)_2 \rightarrow Mg_2As_2O_7 \rightarrow Mg_3(AsO_4)_2 \rightarrow MgO$$

Other arsenates, such as copper arsenate, show the same stability trend. In addition to having the chemical properties mentioned, arsenic trioxide in the gaseous state exists in two forms. The vapor density below 800° C. corresponds with As_4O_6, at 1800° C. with As_2O_3. In the solid state three different forms can be found: a cubic form, a monoclinic form, and an amorphous glass.

In the January, 1959, issue of the *Journal of the American Ceramic Society*, Tryggve Baak reports the results of an investigation, the purpose of which was to answer questions regarding the stability of arsenic in glass from a thermodynamic point of view. Two types of experiments were conducted; the first was of a more preliminary type and was performed in an open system; the second, from which conclusive and quantitative results have been obtained, was done in a closed system.

In each experiment two temperatures are recorded; one is that of the molten glass and the other is the dew point of arsenic trioxide. The vapor pressure of arsenic trioxide (and also that of elementary arsenic) for different temperatures can be found in tables, and thus the vapor pressure at the dewpoint, which is the same as the vapor pressure above the glass. In all experiments except the second one the oxygen pressure has been assumed to be double that of the arsenic trioxide. In the second experiment both the vapor pressures of elementary arsenic and arsenic trioxide were determined. These two values were inserted into the equilibrium expression of reaction, the free energy of which is known, and thus the oxygen pressure in the experiment could be computed.

After each experiment the amounts of tri- and pentavalent arsenic were determined by analyses.

The investigation demonstrated that the vapor pressure of arsenic trioxide over an arsenic-containing glass is appreciable even at temperatures below those of glass manufacturing. This accounts for the loss of arsenic from molten glass. The loss of arsenic is influenced by variations in temperature and oxygen pressure.

The thermodynamic investigation established that in glass the pentavalent arsenic is more stable than the trivalent arsenic. This confirms the observation that the loss of arsenic is less, if saltpeter is added with the arsenic trioxide, by which pentavalent arsenic is formed, and if calcium arsenate is used in place of arsenic trioxde.

THIS IS THE IMAGE OF CF&I ...MAKER OF STEEL

He's a giant steelman. He makes good steel and steel products for the diversified needs of today's economy. He anticipates tomorrow's requirements. He is constantly improving products through research and new manufacturing techniques.

His steel mills extend across the country. In them, he guards every step of manufacturing by rigid quality controls. And in his national network of offices and warehouses, he not only *sells* steel products, but he *serves* their users in every possible way.

He is the dynamic image of CF&I . . . the symbol of dependable steel products. Look for him when you buy.

6583-A

THE COLORADO FUEL AND IRON CORPORATION

DENVER • OAKLAND • NEW YORK

CF&I STEEL

Current Statistical Position of Glass

Employment and Payrolls: Employment in the glass industry during December, 1958, was as follows: *Flat Glass*: a preliminary figure of 19,400 given for December, 1958, indicates an increase of 3.2 per cent over the adjusted 18,800 reported for November, 1958. *Glass and Glassware, Pressed and Blown*: a decrease of 1.0 per cent is shown by the preliminary figure of 81,300 reported for December, 1958, when compared with the adjusted figure of 82,100 recorded for November, 1958. *Glass Products made of Purchased Glass*: the preliminary figure of 14,300 given for December, 1958, is equal to the previous month's adjusted figure.

Payrolls in the glass industry during December, 1958 were as follows: *Flat Glass*: an increase of 13.0 per cent is shown in the preliminary $11,369,142.05 given for December, 1958, when compared with November's adjusted $10,061,174.00. *Glass and Glassware Pressed and Blown*: a decrease of 1.0 per cent is shown in the preliminary $30,704,105.96 reported for December, 1958 when compared with the previous month's adjusted $31,006,237.39. *Glass Products made of Purchased Glass*: a preliminary figure of $4,773,544.78 was reported for December, 1958. This is an increase of 0.8 per cent when compared with the adjusted figure of $4,736,987.26 for November, 1958.

Glass container production: production based on figures released by the Bureau of the Census, Industry Division, was 11,453,000 gross during January, 1959. This is an increase of 8.3 per cent over the previous month's production figure, 10,573,000 gross. During January, 1958, glass container production was 11,714,000 gross, or 2.2 per cent over the January, 1959, figure.

Shipments of glass containers during January, 1959, came to 11,192,000 gross, an increase of 3.8 per cent over December, 1958, which totaled 10,784,000 gross. Shipments during January, 1958, amounted to 10,879,000 gross, or 2.8 per cent under January, 1959.

Stocks on hand at the end of January, 1959, came to 18,771,000 gross. This is 0.5 per cent over the 18,675,000 gross on hand at the end of December, 1958, and 3.9 per cent higher than the 18,051,000 gross on hand at the end of January, 1958.

GLASS CONTAINER SHIPMENTS

(All Figures in Gross)

Narrow Neck Containers

	January, 1959
Food	1,124,000
Medicinal and Health Supplies	1,471,000
Chemical, Household and Industrial	958,000
Toiletries and Cosmetics	794,000
Beverage, Returnable	495,000
Beverage, Non-returnable	78,000
Beer, Returnable	113,000
Beer, Non-returnable	580,000
Liquor	731,000
Wine	408,000
Sub-total (Narrow)	6,752,000

Wide Mouth Containers

Food	* 3,313,000
Medicinal and Health Supplies	389,000
Chemical, Household and Industrial	212,000
Toiletries and Cosmetics	168,000
Packers' Tumblers	30,000
Dairy Products	153,000
Sub-total (Wide)	* 4,265,000
Total Domestic	11,017,000
Export Shipments	175,000
TOTAL SHIPMENTS	*11,192,000

* This figure includes Fruit Jars and Jelly Glasses.

GLASS CONTAINER PRODUCTION AND INVENTORY

(All Figures in Gross)

		Production Jan., 1959	Stocks Jan., 1959
Food, Medicinal and Health Supplies; Chemical, Household and Industrial; Toiletries and Cosmetics	Narrow Neck	4,397,000	6,708,000
	Wide Mouth	* 3,987,000	* 5,940,000
Beverage, Returnable		669,000	1,835,000
Beverage, Non-returnable		90,000	227,000
Beer, Returnable		162,000	494,000
Beer, Non-returnable		715,000	995,000
Liquor		724,000	1,363,000
Wine		462,000	819,000
Packers' Tumblers		36,000	97,000
Dairy Products		211,000	293,000
TOTAL		*11,453,000	*18,771,000

* This figure includes Fruit Jars and Jelly Glasses.

CARBORUNDUM RESEARCH

The Carborundum Company is planning to build a pilot plant for its research and development division in Niagara Falls. It is expected to be completed in 9 to 12 months. The new pilot plant will provide special equipment which the company needs in the production of new products requiring ultra-high temperature processing techniques not now available.

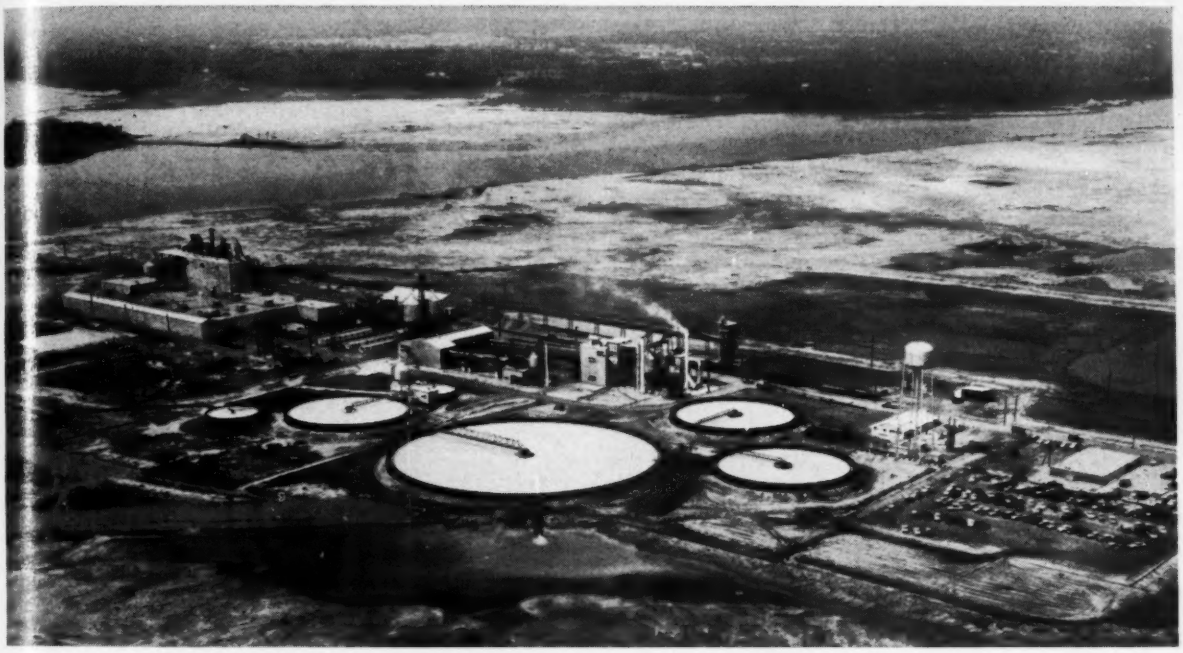
RESEARCH HIGHLIGHTS: NBS

The Annual Report for 1958, National Bureau of Standards Miscellaneous Publication 226, is available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at 45 cents a copy.

This publication presents the highlights of the NBS research and development programs for fiscal 1958 and describes a wide range of scientific studies, laboratory experiments, instrument developments, and technical publications.

Included in the year's review is a commentary on the Bureau's services to science and industry through testing and calibration of measuring instruments and through the distribution of standard samples.

Now! Porter goes basic! The first in the south, this new basic refractories plant at Pascagoula went "on stream" **during February**



Porter's new $12 million Pascagoula Works is a sea-water periclase and basic brick facility using the finest in modern equipment in a fully integrated production unit.

Southern industry will soon begin benefiting from faster deliveries and lower freight rates on all forms of basic refractories from H. K. Porter's new Pascagoula Works on the Gulf Coast. Inland waterways, too, will allow easy access to America's industrial heartland.

Products of this new works—Porter's 15th refractories plant—will include burned, chemically bonded, plated and plain brick, mortars, castables, plastics and ramming mixes of chrome and periclase compositions. A unique double-burning process employed in producing Porter periclase grain insures basic refractory products of the highest quality.

Annual output of this new plant indicates an ample, dependable source of supply. Equally important, Porter engineers and ceramists provide the complete customer service that is rapidly becoming recognized as a Porter principle.

For information on shipments, prices, or *any* refractories problem, write *Pascagoula Works, Refractories Division, H. K. Porter Company, Inc., Porter Building, Pittsburgh 19, Pa.*

PORTER BASIC REFRACTORY PRODUCTS

BASIC REFRACTORY BRICK
(burned and chemically bonded in both metal clad and plain categories)

CM-30	Chrome Magnesite
CM-40	Chrome Magnesite (Roof Brick)
MC-70	Magnesite Chrome
Kilmag	Magnesite Chrome (for rotary kilns, offered in burned and plated only)
M-90	Periclase

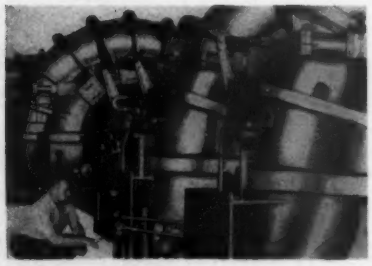
BASIC REFRACTORY SPECIALTIES

Kromtite	Chrome Air-Set Mortar
Plastikrom	Plastic Chrome Ore
Kromor	Ground Chrome Ore
Kromform	Chrome Castable
Subhearth Kromform	Chrome Castable
Airkrom-C	Coarse Chrome Gun Mix
Airkrom-F	Fine Chrome Gun Mix
Magnaram 85	Periclase Ramming Mix, 85% MgO
Magnaram 95	Periclase Ramming Mix, 95% MgO
Peritite	Periclase Air-Set Mortar

REFRACTORIES DIVISION PORTER **H.K. PORTER COMPANY, INC.**

DIVISIONS: Connors Steel, Delta-Star Electric, Disston, Forge & Fittings, Leschen Wire Rope, Moulding, National Electric, Riverside-Alloy Metal, Thermoid, Vulcan-Kidd Steel, H. K. Porter Company (Canada) Ltd.

New Equipment and Supplies



SURGE CONTROL

CDC Control Services Inc., Hatboro, Penna., has developed a fast-responding Compudyne Surge Control System for large compressors, blowers, and exhausters which improves the operating stability, reduces power consumption, and increases the safe output of this equipment. Compressors can be safely operated nearer the surge point.

URANIUM COLORS

Vitro Manufacturing Company is again producing uranium-based colors for the ceramic industry. The Atomic Energy Commission recently lifted its ban on non-nuclear uses of uranium. The new colors are being manufactured at Vitro's Pittsburgh plant, the company having first produced uranium-based colors in 1926.

The uranium salts necessary for producing the new colors are processed from depleted uranium from AEC stocks on an unclassified basis to licensed users.

DOLOMITIC LIME

The Gibsonburg Lime Products Company, Gibsonburg, Ohio, is planning to install an additional rotary kiln that will produce 240 tons of dolomitic lime per day. The company will also install some handling equipment and additional storage, preheater, cooler, and complete grinding, screening and loading facilities.

LAMP & TUBE EQUIPMENT

Kahle Engineering Company, 3330 Hudson Ave., Union City, N.J. has acquired the lamp and tube equipment department of Alfred Hofmann & Company and through this acquisition, will continue to produce the Hofmann line of lamp and electronic tube equipment.

GLASS GRADED SEALS

Glass Products Development Laboratory, 204 Sunrise Highway, Massapequa Park, N.Y., has announced a new and improved process for glass graded seals, for joining hard glass to soft glass and quartz to Pyrex. These seals feature a shorter sealing zone length, according to the company.

FLAME DETECTION

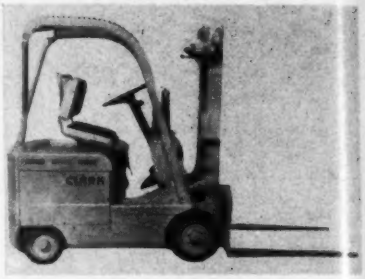
Minneapolis - Honeywell Regulator Company, 2747 Fourth Ave., South, Minneapolis 8, Minn., has a new flame detection device which may be used with all fuels, including gas-oil combinations, and on both single and multiple burners. The tube makes possible the practical use of invisible ultraviolet rays in flame-detection applications; it works with an amplifier circuit in the Honeywell C7012A Ultra Vision Flame Detector system to add up the

impulses of electrical energy generated by the tube as it counts the ultraviolet rays present in all types of flame. The sensor responds only to ultraviolet light, and so it is not affected by hot refractories, incandescent light, hot metal parts or any flickering radiation in the visible or infrared regions. The system can be used to sight temperatures up to 2200° F. without any back light effect.

ELECTRON MICROSCOPE

The Instruments Division, Philips Electronics, Inc., 750 South Fulton Ave., Mount Vernon, N. Y., has announced a new electron microscope which provides up to 2,000,000X magnification by photographic methods. A resolving power of 10 Angstroms or better is guaranteed. The instrument provides 1400 to 200,000X direct magnification for visual observation on the screen or for photographic recordings on 3¼" x 4" plates.

The electron optical system includes a vertical column having six electromagnetic lenses.



BATTERY-POWERED FORK TRUCK

The Industrial Truck division of Clark Equipment Company, Battle Creek, Mich., has introduced three battery-powered, low silhouette fork-lift trucks with a seat height of 34 inches and an overall height of 71 inches to the top of the overhead guard. Controls are automatically timed so that maximum acceleration is provided without excessive current.

AIR COMPRESSOR

Atlas Copco, New York, has introduced an air compressor which delivers 1,075 cubic feet of air per minute at 100 psi. Weighing 6,600 pounds, it may be installed either as a stationary unit or mounted on a skid frame as a semi-portable machine for temporary use.

BATCHING EQUIPMENT

The Howe Scale Company has developed automatic batching equipment incorporating a new formula control component called the Howe Batchplug. The new system is said to provide instant formula changing while completely eliminating any human error. Each standard Batchplug is a self-contained formula which provides complete preset control for up to ten ingredients per formula.

The system can be used in the largest or the smallest automatic batching operations.

CATALOGS RECEIVED

Eisler Engineering Co., Inc., 750 So. 13th Street, Newark 3, N.J., has issued a 20-page catalog illustrating and describing equipment to manufacture vacuum flasks.

The Young Machinery Co., Inc., Muncy, Penna. has a 4-page bulletin and check list announcing a complete line of centrifugal blowers.

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NEW BOOKS

Glass Engineering Handbook, by E. B. Shand, technical consultant, formerly research staff engineer, Corning Glass Works. Second Edition; 488 pages (1958). $10.

An informative volume on the composition, manufacture, properties, and applications of glass as an engineering material. The handbook gives practical data on the use of glass products in industry, research, and various fields of manufacturing, including electron-tube manufacture, the nuclear field, guided missiles, and the automotive field.

In addition to discussing the more commonly known glasses, the book includes information on photosensitive glass, glass-ceramics, electrically conducting glass, glass in electronic circuit components, glass-reinforced plastics, and others.

The Structure of Glass, translated from Russian; 291 pages (1958). $20.

The proceedings of a Symposium on Glass Structure which was held in 1953 in Leningrad. In the Foreword, written by O. L. Anderson and N. J. Kreidl, it is stated that the book "offers the Western scientist a general look at the status of glass science in its many aspects and will introduce the Soviet Scientist by name to his Western Counterpart.

"Surprisingly, this work does not appear dated; the factual portions comprise a definite contribution to the knowledge commonly available to Western scientists, and the controversial portions will add zest to those concerned with the yet unsolved riddle of the structure of glass.

"It is hoped that the contents of this translation will entice the reader to become even better acquainted with Soviet Science."

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Glass Engineering Handbook . . . $10.00
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Modern Glass Practice 7.00
By S. R. Scholes

Properties of Glass 16.50
(Second Edition)
By George W. Morey

Proceedings of the International Commission on Glass 8.00

Recent Translations of Russian Papers

(*Continued from page* 135)

perature retarded the subsequent treatment of the sheets. When the shaft at the 10th pair of the rollers (that is approximately 4 meters above the level of the molten glass) was connected to a vacuum line, the hot air below the 10th pair was removed, while cold air from outside bathed the sheet above the 10th roller pair. This device lowered the temperature of the emerging glass by 40-45°C and accelerated the work of glass cutting after the withdrawal. The hot air removed from the shaft was used for drying ceramic goods. The volume of air bled was 145 cubic meters per hour.

The residual stresses in the glass were not augmented by the accelerated cooling because the temperature at which the cold air first came in contact with the glass was below the temperature range in which residual stresses are formed. When the vacuum line was connected to the shaft at the level of the 6th roller pair (that is about 2.9 meters above the level of the melt), the sheet cracked before reaching the top; the rapid cooling started when the sheet was still in the "sensitive" range of temperatures.

Two heat-enduring glasses

I. I. Kitaigorodskii and N. V. Artamonova describe two high-melting glasses in *Steklo i Keramika* (*Glass and Ceramics*) *14*, No. 7, p. 7 (1957). Their exact composition is not disclosed, however.

The basic composition of SiO_2 72, Al_2O_3 20, CaO 8 per cent approximately corresponded to the eutectic mixture of these three oxides. The coefficient of thermal expansion of this glass was 31.97×10^{-7} per °C. When CaO in the glass was partly supplanted by an equimolecular amount of another oxide, this coefficient in many instances could be further reduced as shown in Table I.

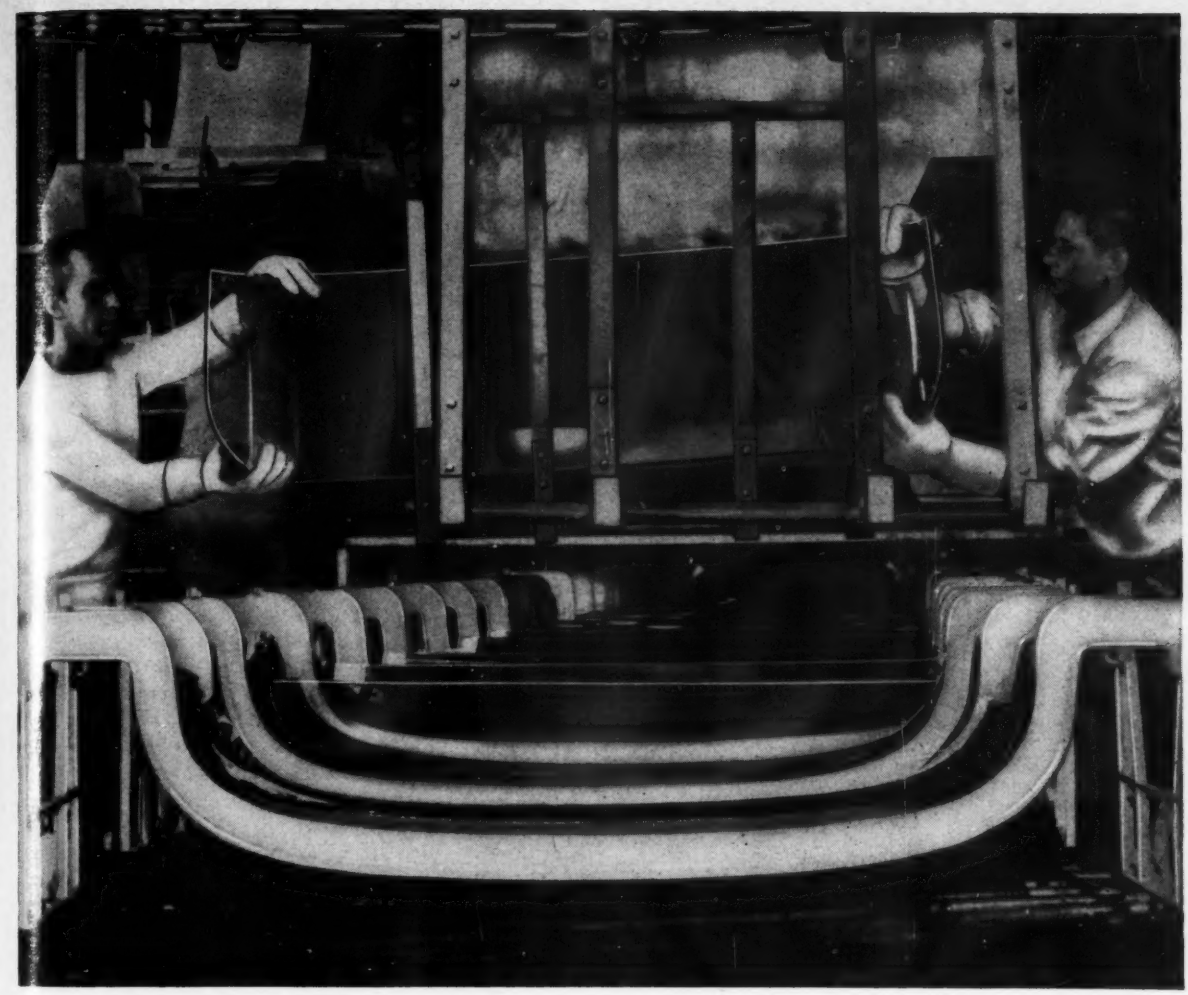
Table I

Coefficient α of thermal expansion of experimental glasses

	Mole per cent of addition	$\alpha \times 10^7$		Mole per cent of addition	$\alpha \times 10^7$
B_2O_3	1	31.9	ZnO	1	31.3
	2	30.3		2	30.0
	3	29.5		3	28.1
	4	28.8		4	25.6
	5	25.7		5	24.8
MgO	2	32.1	BeO	0.5	32.1
	4	31.3		0.75	30.2
	6	31.1		1.0	30.0
	8	28.0		1.25	29.7
	9	25.5		1.5	29.0

To lower the viscosity of the high-alumina glasses, lithium carbonate was introduced in the batch to have 1 - 1.5 per cent Li_2O in the glass. Lithium oxide accelerates the fining of high-melting glasses about as well as does CeO. The thermal expansion of lithia-containing glasses is not recorded in the paper.

(*Continued on page* 152)



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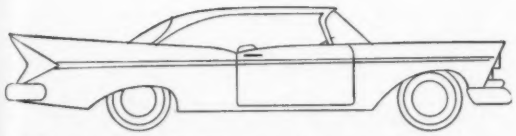

With nearly 7,000,000 cars being produced annually, the increased use of glass has demanded major production improvements in the manufacture of new panoramic windshields and back-lights.

Since the forming of the intricately curved glass is done at a temperature at which glass is soft and can be bent, the production process challenged heat process engineers to design new automatic equipment capable of mass producing these large precision glass pieces.

Selas engineers, working with the nation's leading glass manufacturer, discovered that Gas could produce the proper time-temperature cycle demanded by this process, efficiently, quickly, reliably. The flat glass is conveyed under radiant Gas burners which bring the glass quickly up to bending temperature and allow the shaping of windshields, with reproducible uniformity, at high production rates.

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(*Continued from page* 150)

The batches were made of sand with particles between 20 and 60 microns and other chemically pure ingredients. The melting was performed in chamotte-kaolin crucibles of 300 grams capacity. The maximum temperature of melting and fining reached 1600 - 1620°C. The degree of fining was judged qualitatively from the prevalence of air bells in the glass.

The two best compositions were designated KS-16 and KS-18. Larger amounts of these two glasses were made in quartz crucibles and were present as cylinders of 50 cm. height and 45 cm. diameter. A high-frequency oven was used for heating. When the sand in the batch was coarse (apparently above 60 microns in diameter), poor fining and incomplete dissolution were observed even after heating to 1640°C. When, on the other hand, the sand was finely ground, good dissolution and fining were achieved at a temperature as low as 1580°C. Sand of 1 to 20 microns is advocated.

Glass KS-16 has a tendency to crystallize between 1100 and 1450°C and has a softening temperature of 710°C; its coefficient of heat expansion is 28.4×10^{-7} (per °C); it is resistant to 20 per cent hydrochloric acid but not to 2*N* NaOH. It can be heated from room temperature to 450°C in a few seconds without a crack. Glass KS-18 has an identical crystallization range; its softening temperature is 690°, coefficient of thermal expansion is 25.6×10^{-7}, and chemical endurance is similar to that of KS-16.

VISCOSITY MEASUREMENTS THROUGH 2000° C

As part of the National Bureau of Standards program to develop techniques and instruments for measuring properties of materials at high temperatures, the Bureau's glass laboratory is developing an "oscillating-cup" viscometer to measure the viscosity of liquid inorganic oxides at temperatures up to 2000°C or higher. The feasibility of the method for measurements in the anticipated viscosity range using convenient cup dimensions has been demonstrated with a prototype model.

Values of the viscosity of a liquid and its rate of change with temperature find immediate application in fundamental research on molecular structure. Viscosity data are also of direct use in many technological problems; for example, in calculating forces required for the mechanical transport of a liquid.

However, before such data can be obtained for temperatures above 1500°C, the array of problems that confront nearly all high-temperature measurements must be effectively met. Among the more serious difficulties are those of corrosion and vaporization at high temperatures. Both of these factors produce changes not only in the mass and geometry of the sample, but possibly in its composition as well; stray vapors can react harmfully with critical parts of the apparatus. For greater dimensional stability and reproducibility, it is desirable that the instrument be simple in shape and construction.

In the case of viscosity measurement, there is an additional specific requirement. At sufficiently high temperatures the viscosity becomes so small it can no longer be measured by the techniques in common use for liquids. The instrumentation must therefore be suitable for measuring low liquid viscosities well below the order of 1 centipoise (approximately that of water) for the inorganic oxides.

Oscillating-Cup Principle

The oscillating-cup method appears to be adaptable to the requirements mentioned. The principle of operation is simple. The sample liquid is enclosed in a cup which is suspended from a wire to form a torsion pendulum, and when torsional vibrations are started, the presence of the liquid causes them to be damped. As the amount of damping depends on the viscosity, the latter can be calculated from the observed rate at which the vibrations decay. The mathematical problem of deriving the viscosity from the rate of decay is rather complex, but an adequate approximate solution is available using a high-speed computer.

Decay of amplitude of vibration is exponential with time and only a few oscillations need to be observed to establish the decay rate. This increases the range of viscosities which can be measured in the relatively short times over which the high temperatures are easily maintainable. However, the method is primarily applicable for relatively low viscosities; higher viscosities would require inconvenient cup dimensions.

A prototype of an oscillating-cup apparatus has been constructed to investigate this method of measurement as applied to liquids. Measurements were made on oils having known viscosities in the range of interest and were carried out at room temperature and up to several hundred degrees centigrade.

The results show that the technique is satisfactory as a means of measuring low liquid viscosities. Parallel studies have also been made with a view to selecting materials and modifying the design to adapt it to use at high temperatures. Design of a high-temperature model is now well advanced.

High Temperature Design

Studies of the corrosive effect of boron trioxide on molybdenum, tungsten, and tantalum at temperatures up to 2100°C, have been made for the glass laboratory by Wright Air Development Center. These studies show that, of these metals, molybdenum offers the most resistance to corrosion, with the other 2 following in the order named. Initial plans call for a cup constructed of molybdenum plus 0.5 per cent titanium to counteract embrittlement encountered with pure molybdenum at high temperatures.

The cup will be protected from oxidation by operating it in a vacuum or in an inert atmosphere such as nitrogen or argon made slightly reducing by addition of a few per cent of hydrogen. It is expected that this material will prove satisfactory for temperatures as high as a few hundred degrees above 2000°C. For measurements at still higher temperatures it will probably be necessary to use other materials, possibly new types of ceramics now under development.

Chemical reactions within the cup will be further minimized by the gentleness of the motion between liquid and cup. Reaction products that do appear would tend to remain at the location where they are formed and

(*Continued on page* 154)

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(*Continued from page* 152)

to protect the regions separated by them from further reaction. The effect is analagous to the protection of some metal surfaces from extensive corrosion by the formation of a light metal-oxide coating.

High temperatures will be produced by induction heating and will be measured by optical pyrometry. Maintenance of a constant uniform temperature will be facilitated by the relatively small size of the oscillating cup as compared with the measurement cells of familiar types of liquid viscometers.

The cup will be affixed to a rigid rod which will extend outside the high-temperature zone, so that all moving parts of the apparatus except the cup can be maintained at lower temperatures where their operation is much more convenient. The rod is to be suspended from a torsion wire on which the rod and measurement cup oscillate as a unit. Measurement of the vibration amplitude will be made with a telescope directed toward a mirror attached near the top of the rod.

In addition to the work on the oscillating-cup viscometer, it is planned to explore the possibility of determining viscosity at high temperature from measurements on the damping of ultrasonic oscillations of a small probe immersed in the experimental liquid. An attempt will first be made to modify commercially available probes to high-temperature use. The glass laboratory is also planning a survey of general techniques and specific designs for the measurement of surface tension at high temperatures, with the aim of selecting one or more for intensive development effort.

PEMCO EXPANDING IN NEW BUILDING

Pemco Corporation is constructing a new building with twice the area of the previous installation devoted to the manufacture of color. It will have a floor area of 30,000 square feet.

KAISER CHEMICALS EXPANDS

Kaiser Chemicals division, Kaiser Aluminum & Chemical Corporation, is expanding its basic refractory brick capacity at its Columbiana, Ohio, plant for the second time in three years. When completed late this year, Kaiser will be able to produce an annual combined total of over 200,000 tons of basic refractory brick and mixes at its Moss landing, California, and Columbiana facilities.

Glass Container Molds

(*Continued from page* 131)

It was found that the lightly soiled parts were perfectly cleaned, but the scale on the heavily soiled parts was only loosened by this treatment, provided that the parts had been degreased.

Combined Chemical and Electrolytic Cleaning

A combined chemical-electrolytic method of cleaning was attempted on heavily soiled parts using the previously mentioned 25 per cent sodium hydroxide solution with a chelating agent. First the parts were degreased in benzine for approximately 5 minutes. This dissolved the oil in the layer of scale, and the scale itself became

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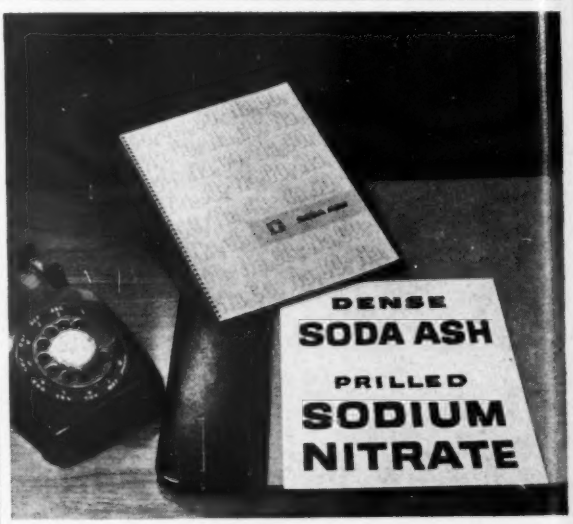

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sufficiently crumbly on its outside so that it could be partially removed by brushing. The parts were then immersed in the sodium hydroxide solution at 90°C for 30 minutes. This loosened more of the scale, which was removed by brushing. The parts were then cleaned electrolytically for five minutes at 25°C in an identical sodium hydroxide solution. The polarity of the electrodes was reversed every 25 seconds. Any scale remaining after this treatment was easily removed by running water, and the parts became bright and clean.

Ultrasonic Cleaning

Ultrasonic cleaning was attempted on some of the smaller parts which had already been subjected to the alkaline cleaning methods previously described. The parts were placed individually in a container on an ultrasonics generator, but they could not be arranged so that all of the surfaces received equal intensities. Therefore, the results could not be considered conclusive.

Frequencies of 22 KC and 175 KC were used, with the lower frequencies proving to be more effective. Applying the treatment for one minute at an intensity of 3 watts/cm.^{2} proved sufficient to remove any loose scale.

Parts which had been treated both chemically and electrolytically were more effectively cleaned by ultrasonics than those which had only been treated chemically. In all cases, when the parts were first degreased, the final results were improved.

It was interesting to note that scale adhering to kerfs, boreholes, and other areas unreachable by a brush, could be completely removed by the ultrasonic treatment, while scale adhering to plain, open surfaces was more readily removed by brushing.

Conclusions

These tests show that moderately scaled molds or mold parts can be effectively cleaned by one or several of the methods suggested, depending on the degree of scaling. Furthermore, even the most heavily scaled mold parts can be cleaned with a four-step process consisting of (1) degreasing, (2) chemical cleaning, (3) alkaline-electrolytic cleaning, and (4) ultrasonic cleaning. An important feature of the chemical and electrolytic cleaning methods is that the loss of mold metal is minimized through the use of a chelating agent.

Annealing Glass Containers by Radiant Heat

(*Continued from page* 132)

radiant heating now being used, production averages 20 per minute. Increased production rates on the other sizes correspond with these figures.

Lehrs which have operated for over a year and a half with radiant heat burners have also proved outstanding in operating economy.

The roof panel and bottom burner arrangements, totaling almost 100 burners in each lehr, are confined to a space only a little over 2 feet in length in direction of belt travel. This shorter heating zone not only saves time, as evidenced by the increased production figures mentioned above, but saves appreciably on space requirements and the initial equipment costs.

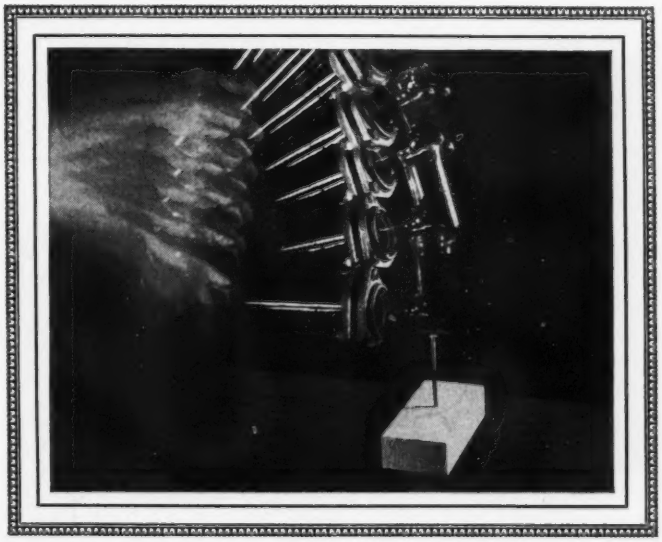
The labor cost has been reduced also. In lehrs with

How well do you know your glass?

THIS PICTURE ILLUSTRATES A:

- ☐ 1. New type of hammer
- ☐ 2. Laboratory test for glass endurance
- ☐ 3. High-resistance fiber glass
- ☐ 4. Durable glass piping

If you checked No. 4, you hit the nail on the head, so to speak. Corning Glass Works' development in 1950 of glass piping so strong it can be used to drive a nail into wood finds wide application in industry. So, too, does Wyandotte Soda Ash – supplied by Wyandotte to the glass industry for nearly 70 years. Today, as in the past, Wyandotte is a working partner supplying technical assistance and raw-material chemicals to those great companies marking milestones in glass progress.



Wyandotte CHEMICALS

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conventional burners, batch changes usually required a resetting of belt speed, an adjustment in temperature controls and a resetting of blowers, by skilled operators.

The converted lehrs require only a change in belt speed, which is taken care of by an easily operated gear shift, and an occasional adjustment of roof height for different size containers, which is accomplished by turning a handwheel.

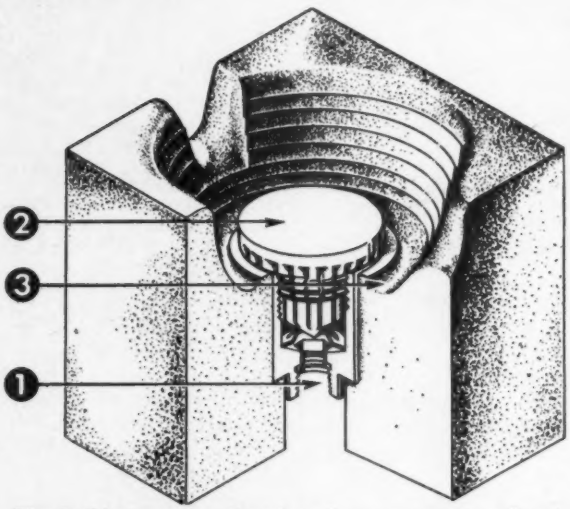

Fig. 2. Diagram of radiant heat burner operation. Gas-air mixture enters mixture tube *1* and proceeds to burner tip *2*. After passing through tip, mixture is distributed radially and burns within refractory cup *3* in a petal-shaped formation. Inner contour of cup is shaped so that surface is always "washed" by hot combustion products, regardless of operating rate.

The ability to adjust accurately the temperature of different burner groups has made possible a great versatility in setting the heat pattern. Two Flomixers* are used for the top and two for the bottom sets of burners. In each case, the first and second group of burners can be individually controlled by an air valve ahead of the mixers. A control valve on the combustion air line is provided to throttle all the burners when the temperature control instrument shows total heat input is too great.

Heating Zone Instrumentation

The instrumentation we use in the lehrs (Fig. 3) also helps to reduce operating costs. With completely automatic indication, recording and control of heating temperatures, constant attendance is no longer necessary; only periodic loggings of cooling-zone temperatures is now required. The continuous, long-term record of temperatures obtained this way provides a sounder basis for efficiency calculations—"heating-time vs. belt-speed" tables and the like—than readings made at sporadic intervals.

In operation, a circular scale controller that indicates actual temperature measurement is connected to two series-connected thermocouples located in the annealing zone. The unit, which is preset to maintain the required annealing temperature, is governed by the temperature-average of the two thermocouples and varies the flow rate of the total gas-air mixture when necessary.

A strip chart recorder is connected through a selector switch to a number of thermocouples located throughout the lehr and makes a continuous, permanent record of temperatures at desired locations.

As the burners are extremely sensitive to control, the slightest change in fuel flow rate gives instant response. The annealing temperature is always kept within a very few degrees of the set-point, which is held constant for all glass containers. There is, accordingly, no need for set-point adjustments for changes in container size.

Cooling Zones

A Honeywell Millivoltmeter Indicator is used in conjunction with a manual selector switch to read temperatures at ten different points in the lehr cooling zones. The readings are logged manually at regular intervals and used to adjust blowers in the cooling area, when necessary.

Gradual cooling to about 500°F takes place in the first cooling zone at a pre-arranged rate over a length of approximately 45 feet. Comparatively rapid forced air cooling is next employed to bring glass containers back to an approximate room temperature when they leave the lehr. The ware is then ready for inspection and packaging.

Maintenance Costs Reduced

We have achieved greater economy on maintenance than originally anticipated through the use of radiant heat in the lehrs.

The biggest saving of all has been attained on increased belt life. As all heat to the ware bottoms has to pass through the belt, elimination of flame impingement has resulted in surprisingly long belt life. Even in those lehrs converted over a year and a half ago the belts are still in excellent condition.

Other savings worth mention: We no longer use blowers in the heating area. Only one cleaning of each combustion system has been necessary since installation 1½ years ago.

The company's experience with lehrs converted to radiant heat has been highly successful. Production has been increased considerably, heating costs reduced, and the efficiency of all operations greatly improved.

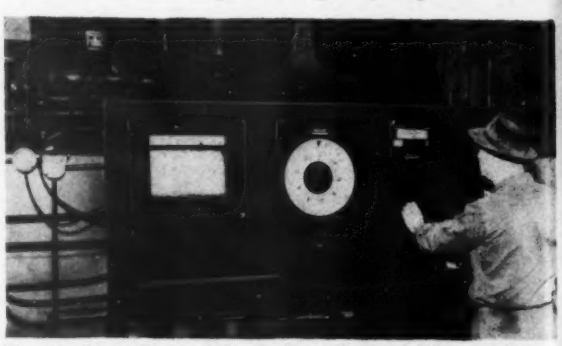

Fig. 3. Control panel for radiant heat in lehr. At left is strip chart recorder for annealing zone temperature. Temperature control, center, regulates flow of gas-air mixture to burners. Indicating millivoltmeter is used with manual selector switch to measure temperatures at 10 different points in cooling zones.

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Westvaco Soda Ash has the ideal crystal size and shape to minimize segregation during batching, charging and melting. That means an optimum melt rate, uniform distribution of the flux, economical furnace temperatures, homogeneous glass *and* less checker clogging.

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Unlike traditional cube-shaped ash, Westvaco Soda Ash is composed of billions of tiny, needle-shaped crystals. Each tiny crystal has more surface per unit of volume so the melt rate is high. Being roller-shaped, the crystals do not grind each other to a powder during batching and charging. The crystals flow freely yet their natural tendency to interlace like twigs minimizes sifting and segregation. Carryover to the checkers is nil.

All of these advantages are now well known to Westvaco Soda Ash users. They may be available to you at no extra cost if your plant is located in our economic shipping territory. Why not let's discuss both the advantages and the arithmetic of Westvaco Soda Ash . . . soon?

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Instrumentation in Great Britain

(*Continued from page* 130)

gage, a gas analysis apparatus (portable or fixed), one or several optical pyrometers and temperature indicators or recorders. Measurement of fuel input, such as volume of clean gases and light fuel oils, hot raw producer gas, creosote pitch, etc., has been introduced. Metering of air supply for combustion is also performed. Automatic stack damper control has been installed, and it is claimed that up to 5 per cent of the fuel can be saved. The use of a heat flow meter for determining optimum combustion and heat transfer conditions within a furnace is, of course, highly desirable, and so is installation of a glass-level gage that will continuously indicate and record the glass level in a tank furnace feeding automatic machines. (Fig. 9a).

Fig. 7e. Illuminated large dial for reading measured values from a distance.

An Isotope Level Gage

Radio-isotopes from nuclear reaction are available in a great variety for industrial uses in Great Britain. As far back as 1944 samples of powdered glass have been treated with a radioactive solution and then heated. The effect of radiation was observed in an ionization chamber. Thus fusing and sintering properties of powdered glass could be observed. Tests have been carried out to determine resistance of refractory materials against corrosion from molten glass. By exposing a specimen of a new ceramic material to thermal neutrons produced in a nuclear reactor, the corrosive resistance can be established without using a pilot plant.

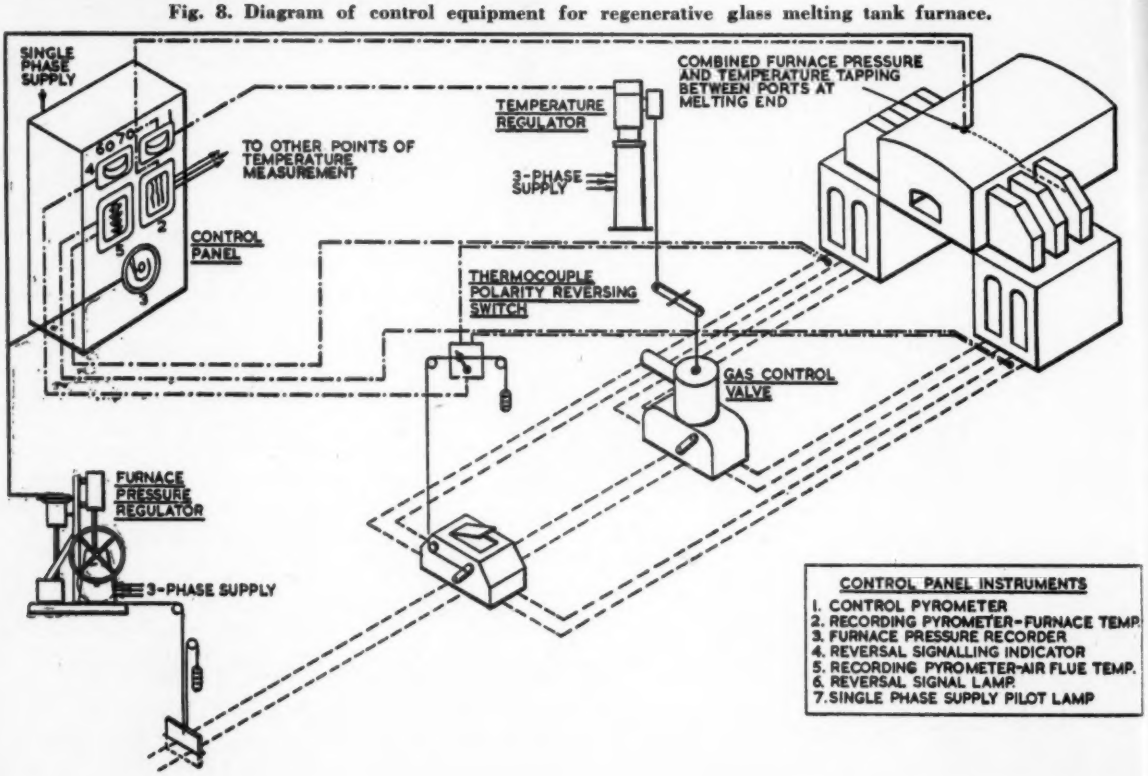
For several years radio-isotopes, which emit gamma rays, have been harnessed to indicate the level of contents in tanks, storage vessels, etc. Space does not permit going into details, but in the following a notable British instrument will be described as used in the glass industry.

Isotope Developments Ltd. of Reading, England, has designed their "I. T. D." liquid level gage for indication or control of liquid level. The instrument has been developed to fill requirements where the more conventional types of gage cannot be used. (Fig. 10).

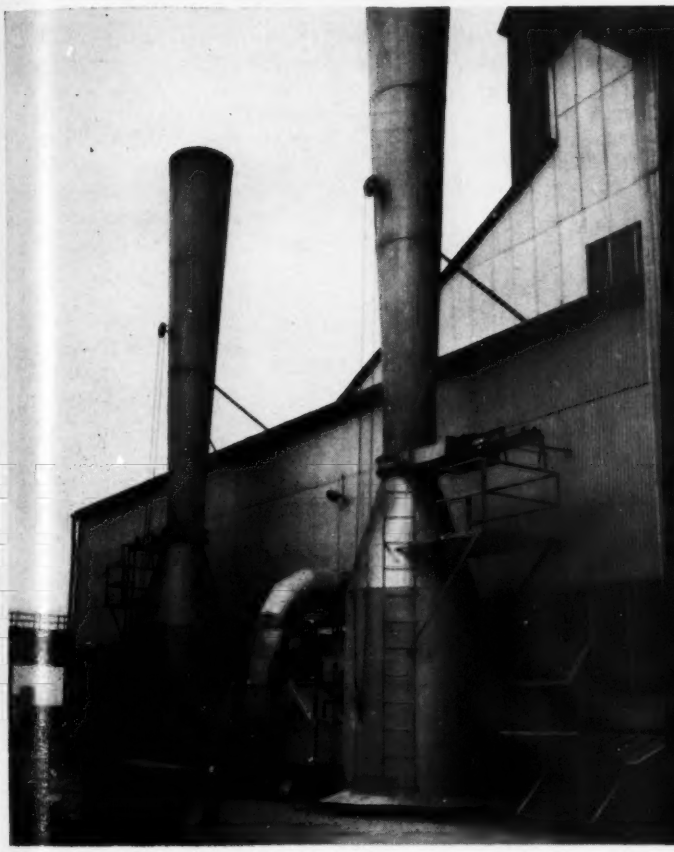
The I. T. D. level gage operates by passing a radioactive beam through the walls and lining of a furnace

(*Continued on page* 160)

Fig. 8. Diagram of control equipment for regenerative glass melting tank furnace.



PERFORMANCE PAYS



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RECENT INSTALLATIONS

Morgan Ejectors . . . Glass Melting Furnaces

Metro Glass Bottle Company	Jersey City, N. J.	1	**Owens-Corning Fiberglas Corporation**	Kansas City, Kans.	3
Libbey-Glass Company	Toledo, Ohio	1	**Houze Glass Company**	Point Marion, Pa.	1
Indiana Glass Company	Dunkirk, Ind.	2	**Thatcher Glass Company**	Saugus, Calif.	2
Obear Nester Glass Company	East St. Louis, Ill.	1	**Vermont Associated Lime Company**	Winooski, Vt.	1
Knox Glass Company	Knox, Pa.	1	**Hazel-Atlas Glass Company**	Various Plants	3
Columbia Brewers	New York, N. Y.	1	**Pittsburgh Plate Glass Company**	Clarksburg, W. Va.	1
Frazier-Simplex, Inc.	Washington, Pa.	1	**Ford Motor Company**	Detroit, Mich.	1
McKee Glass Company	Jeannette, Pa.	1	**Maryland Glass Company**	Baltimore, Md.	1
Canadian Pittsburgh Industries, Ltd.	St. Laurent, P.Q., Canada	1	**Laurens Glass Works**	Laurens, S. C.	1
T. C. Wheaton	Millville, N. J.	1	**Glass Containers Corporation**	Vernon, Calif.	1
Liberty Glass Company	Sapulpa, Okla.	2	**Gustin-Bacon**	Kansas City, Kans.	1
					29

Morgan-Isley Furnace Systems . . . Glass Melting Furnaces

T. C. Wheaton	Millville, N. J.	2	**Pittsburgh Plate Glass Company**	Creighton, Pa.	1
Hazel-Atlas Glass Co.	Various Plants	7	**Metro Glass Bottle Co.**	Dalton, Ill.	1
Hartford-Empire Company	Hartford, Conn.	2	**Owens-Illinois Glass Co.**	Portland, Ore.	2
Kimble Glass	Vineland, N. J.	2	**General Electric Co.**	Somerset, Ky.	1
			Gallo Wine Company	Modesto, Calif.	1
					19

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(*Continued from page* 158)
forehearth directed at a position along the level of the liquid material inside. The radiation passing through the entire plant is then picked up by a suitable water-cooled detectng unit on the far side. As the equipment is mounted externally, the gage is particularly suitable for measuring levels of liquids contained under drastic conditions of temperature or pressure and of a corrosive nature, such as those of molten glass in a furnace, slag in a blast furnace, liquids in high pressure polymerization vessels, and liquid handling in the oil industry.

The equipment consists of a radioactive source, usually Cobalt 60, with a working life of approximately five years; a detector unit, water cooled if ambient temperature exceeds 60° C.; and an amplifier which may be located up to 60 ft. from the detector. The source and detector are mounted on opposite sides of the vessel.

When the liquid level is high the radiation entering

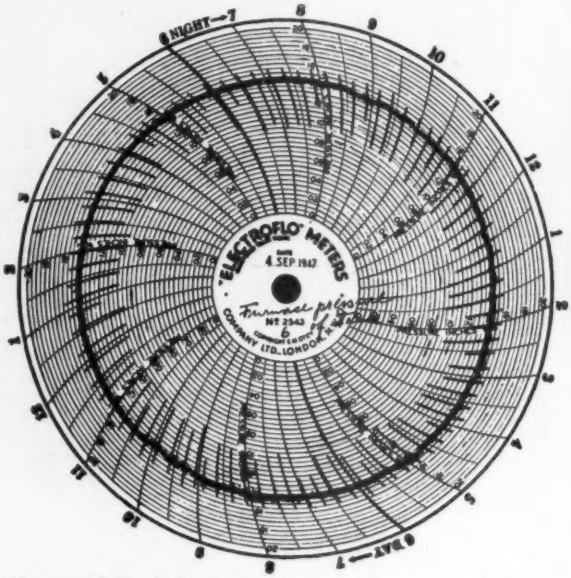

Fig. 9. Typical furnace pressure chart on regenerative glass tank.

the detector is reduced, and when the liquid level falls the amount of radiation in the detector increases. Over a given vertical distance, therefore, the amount of gamma radiation entering the detector is proportional to the level of the liquid. The precise accuracy achieved and the specified limits depend on the diameter of the vessel, wall thickness and nature of wall, and the amount of surround, such as lagging.

In general, the gage will accommodate an internal diameter of plant which does not exceed 10 ft., but under certain circumstances with reduced accuracy it may be possible to accommodate up to 20 ft. in diameter. The maximum vertical change in liquid level over which the gage operates is 15-18 in. Over this change, the order of accuracy of indication or control is ± 2 per cent.

The gage has already been applied in the glass industry to a glass furnace feeder, the internal diameter of which is approximately 3 ft., the surrounding insulating brick on either side of the furnace being approximately 9 in. thick. Under these conditions, the gage indicates or controls the liquid level over a rise and fall of 0.5 in. The accuracy achieved over the center 0.25 in. is 0.02 in. or, over the entire 0.5 in., is 0.04 in.

Since the liquid level gage operates completely externally to the industrial plant and the detector unit is water-cooled, the instrument is independent of internal charges in the plant which involve high temperature, pressure vacuum, or the processing of extremely corrosive liquids.

There are other uses of isotopes in successful operation in British glassworks. For example, one system uses a radio-isotope installed on the side of a glass furnace forehearth, controlling the amount of glass fed to bottle molds by means of automatic controls. It is well known that any variation in the amount of glass supplied to molding machines would result either in thin-walled bottles or in damaged molds, through under, or over-feeding.

The level gage maintains the level of glass to an accuracy ± 1/16 in.

Fig. 9a. Glass tank furnace instrument panel.

The isotope source and the detector are mounted at the correct working level. Changes in level cause variation in the total absorption of gamma rays. Thus the signal output from the detector is varied. This output is amplified remotely and used to operate an indicator and/or a chart recorder. The signal is also utilized to actuate an automatic level control instrument. The isotope used for this type of work is cobalt 69, which has a half-life of about 5 years. For certain uses cesium 137 may be employed which is a longer-lived source.

The above brief survey has dealt only with a few British-made instruments, selected at random from the notebook of the writer. There are many more makes of instruments and many instrument uses in the British glass industry in operation, which could not be dealt with.

Acknowledgment is due to the instrument firms which supplied data and illustrations. (*Continued on page* 162)

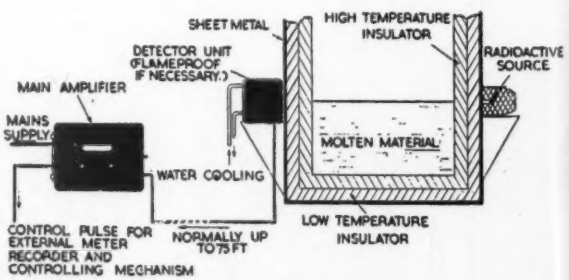

Fig. 10. Isotope glass level gage.

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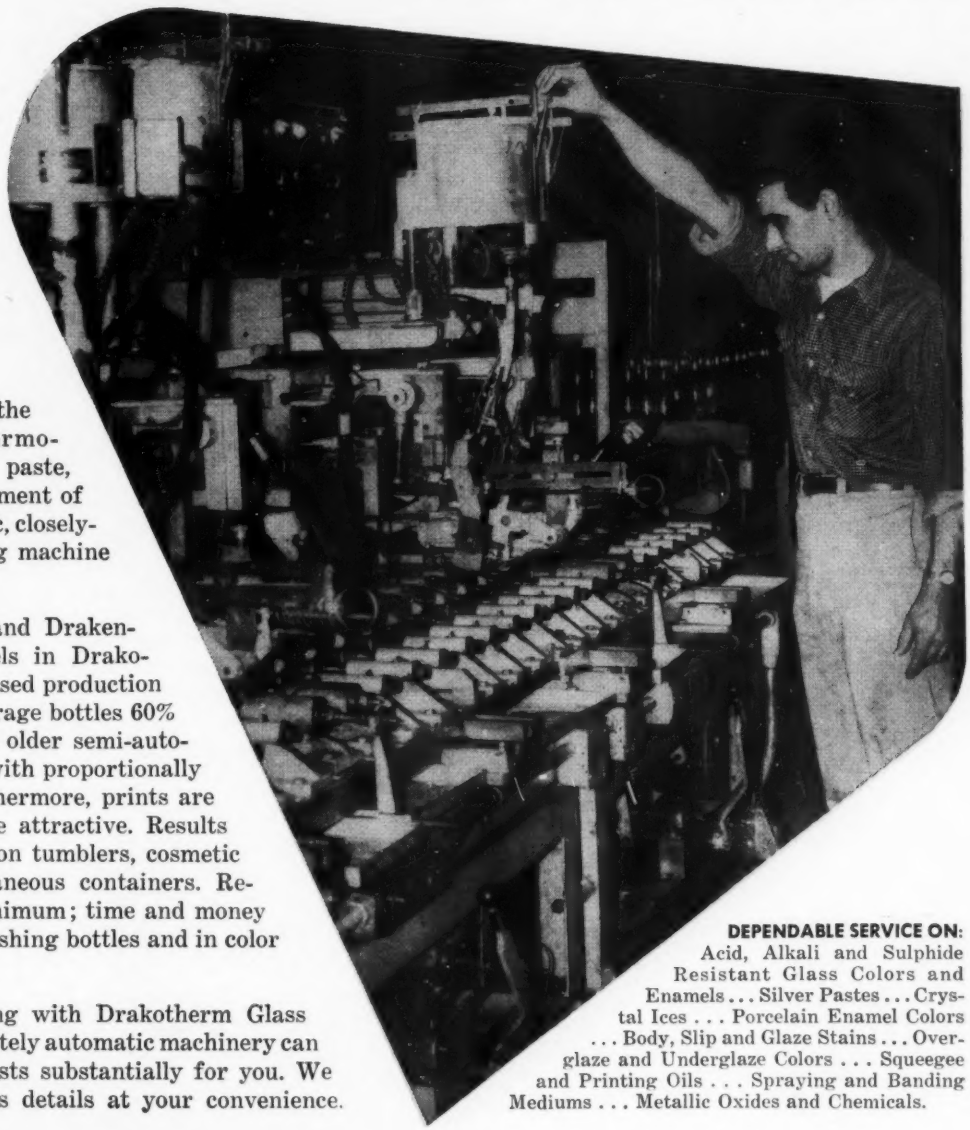

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75-6

(*Continued from page* 160)

BIBLIOGRAPHY

Level Control in Glass Melting Tanks. Publ: George Kent Ltd., Luton, England.

Glass-level and Gob-weight relationship in Automatic Feeder operation. Griffin, Light & Russell. Publ: Bull, Amer. Ceramic Soc., May 15, 1950.

Picture Credits

Cambridge Instrument Co. Ltd., London: Figs. 7d, 7e.
Electroflo Meters Co., London: Figs. 1, 8, 9, 9a.
Fielden Electronics Ltd., Manchester: Fig. 6.
Foster Instrument Co. Ltd., Letchworth: Figs. 4, 4a.
George Kent Ltd., Luton: Figs. 2, 3, 5a.
Isotope Developments Ltd., Reading: Fig. 10.
Jackson Bros. Ltd., Knottingley: Fig. 2b.

Inventions and Inventors

(*Continued from page* 143)

to said horizontal plane. This thrust holds together the elements thereof during differential lateral movements of the inner and outer roof faces due to expansion or contraction of the roof.

There was 1 claim, and the following reference.

United States Patents

1,394,471, Charles, Oct. 18, 1921; 1,512,004, Stevens, Oct. 14, 1924; 1,738,527, Dobie, Dec. 10, 1929; 2,142,-762, Reynders, Jan. 3, 1939; 2,263,848, Keaney, Nov. 25, 1941; 2,444,365, Pluck, June 29, 1948; and 2,641,-207, Pollen, June 9, 1953.

Foreign Patent

630,541, Great Britain, Oct. 14, 1949.

Glass Compositions

Glass paper-calcium silicate. Patent No. 2,823,117. Filed November 23, 1953. Issued February 11, 1958. No sheets of drawings; none reproduced. Assigned to L-O-F Glass Fibers, Inc., by Dominick Labino.

A glass composition produced from sand and soda (Na_2CO_3) and consisting essentially of about 74.5 per cent silica and 25.0 per cent sodium oxide and 0.5 per cent R_2O_3 is made molten and drawn into filaments having a diameter in the range of 0.002"–0.004". These filaments are then passed through a hot gas blast having a temperature in the range of 3000-3300°F. at a blast velocity on the order of 1600-2000 feet per second and the filaments are further attenuated by the blast to fibers having a diameter of 0.01 to 1 micron; fibers which average 1 micron in diameter are suitable and the suitability for many purposes increases with decrease in diameter. The blown fibers are collected on a suitable screen and are ready for leaching.

Preferably the leaching takes place immediately after blowing and, in any event, within forty-eight hours of blowing to achieve optimum results. A long period of storage of the sodium silicate fiber, particularly under humid conditions weakens the fiber due to a self-leaching effect wherein the alkali remains on the fiber surface and deleteriously affects the same.

To effect leaching on a laboratory scale 57 grams of the sodium silicate fiber are added to a 5 per cent solution of calcium chloride containing 80 grams of the chloride by weight and the mass is heated to boiling for about 15 minutes. The solution is then poured off from the fiber and the fiber is washed with water free of any alkali or excess of calcium chloride remaining.

This fiber, when first dried at room temperature and then heated to 100°C. lost in the heating 2.35 per cent in weight, which percentage is based on the dry weight and is considered to represent the moisture content of the fiber. The heated fiber contained approximately:

Constituent	Percent by wt.
SiO_2	74.5
CaO	5.86
R_2O_3 (Al_2O_3, Fe_2O_3)	1.7
H_2O in combination	Balance

When fired to 1000°C. the loss in weight was 14.74 per cent total and the fiber analysis was approximately:

Constituent	Percent by wt.
SiO_2	85.4
CaO	6.71
R_2O_3 (Al_2O_3, Fe_2O_3)	1.95
H_2O in combination	Balance

The molal ratio of SiO_2 to CaO then calculates to approximately 12:1. This ratio has been found to be somewhat variable with the time of heating and the concentration of calcium chloride but the CaO apparently does not replace the Na_2O completely due to tendency of the fiber while leaching to take on some water in place of Na_2O. Consequently the CaO present will always be less than the Na_2O percentage in the original filament or glass; this is advantageous since a high silica product, which itself could not be formed into very fine submicron diameter fibers, is thus attained.

The water molecules are completely removed from the fiber by heating at temperatures above 1000°C. and below the fusion point—the temperature being variable dependent upon the SiO_2: CaO ratio; this temperature is about 1100-1200°C. at a ratio of 12:1.

The calcium silicate fibers achieved in the practice of the invention readily mat together when wetted. Thus, to form a paper or filter it is simply necessary to disperse the fibers in water and to pour the slurry through a screen which retains the fibers; upon drying, a mat useful as a filter and consisting only of fine fibers is attained. Such a filter when subjected to a solution which had been repeatedly run through commercial filters, likewise made from fine fibers, turned brown with the material picked up despite the fact that the testing with the other filters had indicated all matter to have been removed. This capacity for filtering is considered to stem from the ion exchange capabilities of the calcium constituent present in the paper.

The paper itself was soft and relatively sleazy but a hand-sheet thereof had good tensile properties equivalent to other filter papers.

There were 15 claims and the following references cited in this patent.

United States Patents

650,042, Doak, May 31, 1898; 1,907,868, Powell, May 9, 1933; 2,308,857, Bowes, Jan. 19, 1943; 2,334,961, Schoenlaub, Nov. 23, 1943; 2,491,761, Parker, Dec. 20, 1949; 2,526,870, Jelinek et al., Oct. 24, 1950; and 2,658,848, Labino, Nov. 10, 1953.

(*Continued on page* 164)

August 1, 1958

Two days earlier, this was a feldspar plant. Less than three months later, a new mill rose out of the ruins. Here's how Consolidated Feldspar's Custer plant made it . . .

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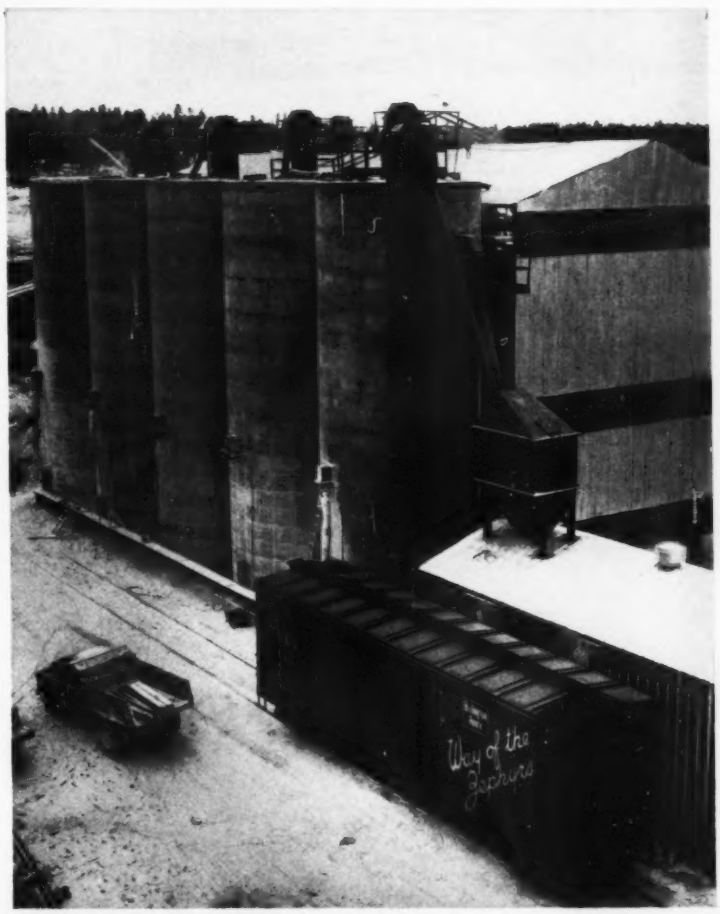

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(*Continued from page* 162)

Glass wool and fiber

Process for preparing an asphalt-bonded glass fiber mat. Patent No. 2,811,769. Filed August 10, 1954. Issued November 5, 1957. One sheet of drawings; none reproduced. Assigned to Lubrizol Corporation by Willis G. Craig.

A fibrous mat is prepared by the process which comprises the steps of: (a) forming a relatively loosely piled mass of fibers; (b) compacting such mass by flowing water thereon; (c) depositing on the surface of such compacted mass a discontinuous layer of discrete particles of said thermoplastic material; (d) heating the thus prepared mass to drive off substantially all of the water and to fuse and coalesce said discrete particles of thermoplastic material; and (e) cooling such mass.

Immediately after the mass has been thus felted and while it is still wet, it is treated uniformly with a thermoplastic material. This thermoplastic material may be selected from such materials as asphalt, polystyrene, shellac, Celluloid, cellulose acetate, polyvinyl acetate, nylon, polyesters, and in fact from a wide variety of other linear polymeric materials. The treatment usually will consist in directing a fine spray of the molten thermoplastic material at the felted fibrous mat, although the scope of the invention contemplates likewise a variation whereby a cold granlar thermoplastic material is dusted onto the felted fibrous mat. It is an important feature of the hereindescribed process that, regardless of the physical state of the thermoplastic material it must be distributed uniformly over the top surface of the mat. The amount of such thermoplastic material which is so distributed on the mat will vary from 20 to 200 percent of the weight of fibrous material.

The fibrous mat next is heated so as to evaporate the water therefrom. The temperature at which this heating step is performed is such that the water will be evaporated from the mat within a reasonable length of time, and while any temperature above about 200°F., under atmospheric pressure, is satisfactory, for reasons of time it is preferred to utilize a higher temperature; i.e., of the order of 300°-1000°F.

One particularly useful application is as a roofing material, especially for commercial roofing.

There were 3 claims and the following references cited in this patent.

United States Patents

2,305,516, Coss et al., Dec. 15, 1943; 2,331,146, Slayter, Oct. 5, 1943; 2,372,433, Koon, Mar. 27, 1945; 2,457,784, Slayter, Dec. 28, 1948; 2,477,555, Roberts, July 26, 1949; 2,550,465, Gorski, Apr. 24, 1951; 2,569,160, Heritage, Sept. 25, 1951; 2,695,257, Castellani, Nov. 23, 1954; and 2,702,069, Lannan, Feb. 15, 1955.

Material in glass fiber and new industrial product resulting therefrom. Patent No. 2,810,405. Filed June 30, 1955. Issued October 22, 1957. One sheet of drawings; none reproduced. Marguerite Huau. No Assignee.

Materials are known which are composed of unstranded glass fiber filaments, wherein the warp and

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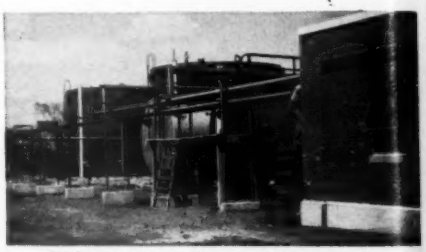

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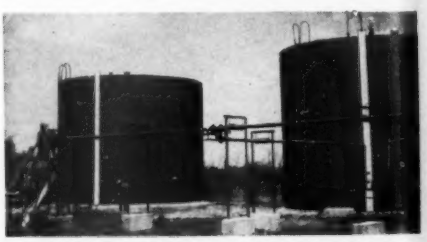

Bulk storage tanks with interconnecting, unloading and transfer lines.

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weft are not woven and the two layers are merely disposed in superjacent relationship and assembled by auxiliary binding filaments.

These materials, as compared with the fabrics produced by conventional methods, have considerable resistance to elongation, such resistance being due firstly to the fact that the filaments are not stranded and secondly to the fact that the filaments remain straight, the weft and warp having no effect one upon another.

These advantages are accomplished by passing the said binding filaments alternately above and below the main filaments, one binding filament being disposed in the weft direction and another binding filament being disposed in the warp direction. This method means that the auxiliary binding filaments are to some extent woven with the main filaments and, even if the binding filaments are moderately stretched, this method produces undulations in the main filaments, which undulations considerably reduce the resistance to elongation of the finished materials.

According to the invention the binding filaments comprise a warp and a weft which are woven together but which are not woven with the main filament.

There were 4 claims and the following references.

United States Patents

1,964,419, Asten, June 26, 1934.

Foreign Patents

49,327, France, Apr. 19, 1861 and 1,073,842, France, Mar. 24, 1954.

Sheet and Plate Glass

Method of application of water-soluble carbohydrate to heated annealed glass. Patent No. 2,824,411. Filed December 24, 1952. Issued February 25, 1958. No sheets of drawings; none reproduced. Assigned to Libbey-Owens-Ford Glass Company by David H. Goodwillie and Wilbur F. Brown.

It is an aim of the present invention to provide an entirely new method of protecting glass sheets from stain, weathering and scratches, eliminating the necessity for washing, acid dipping and the use of paper or similar protective means.

This purpose is accomplished in a preferred form of the invention by first buffing the sheet of glass to remove surface dirt and then coating both sides thereof with a skin-tight protective coating, preferably of a water-soluble carbohydrate or saccharid such as glucose or dextrin.

Both water-soluble starches and sugars can be used, or partially hydrolized starches such as dextrin. By way of example only, a dilute solution of dextrin or glucose gives very good results. The consistency of the solution will depend largely on the manner in which it is to be applied, the thickness of coating desired, and the degree of transparency.

A very satisfactory solution can be made from one pound of dextrin or glucose dissolved in 1000 gallons of water, with enough muriatic acid to give a solution that is neutral or slightly on the acid side. Obviously, other ingredients can be added to the solution for various

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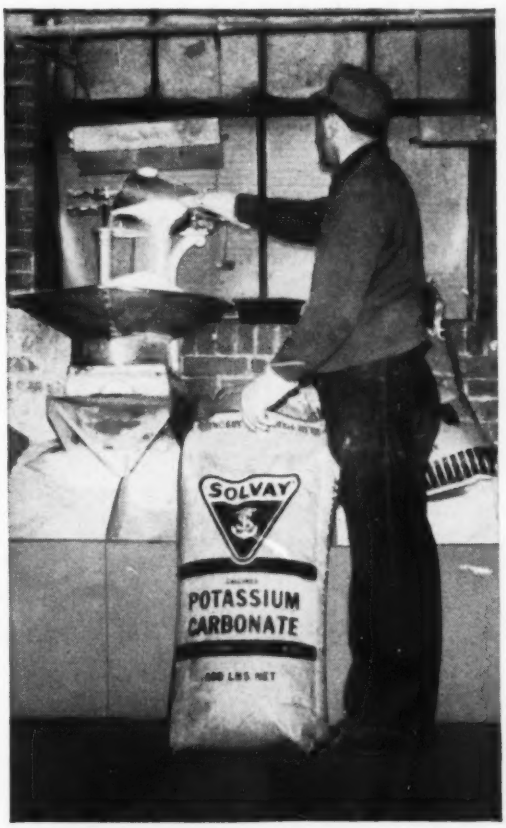

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purposes, and a vehicle other than water may be employed to give faster drying if desired, so long as it does not injuriously affect the glass surface.

Coatings from .001 to .003 inch thick will give adequate protection from weathering and staining, will be sufficiently transparent to allow inspection of the glass for defects, and will permit the coated glass to be cut with regular cutting equipment. However, somewhat thicker coatings can be used when greater protection from scratching and abrasion is desired, without seriously interfering with the other good qualities of the material. In addition to added thickness, further protection can be obtained by using a filler such as wood flour or other protective material in the solution. Or, when it is desired to give further insurance against the coated surfaces sticking together, finely divided wood flour, or other powdered material can be dusted onto the coated surface.

Dilute solutions of water-soluble carbohydrates will dry quickly into a protective coating when applied to glass at the temperature at which it emerges from the lehr, and it is desirable to maintain the coated glass out of contact with the supporting rolls until the coating has set.

There were 4 claims and the following references cited in this patent.

United States Patents

284,659, Oudin, Sept. 11, 1883; 632,014, Hackelberg, Aug. 29, 1899; and 2,376,743, Wendt, May 22, 1945.

Tube and Cane Machines

Apparatus for making tube envelopes. Patent No. 2,857,870. Filed June 24, 1950. Issued June 10, 1958. No sheets of drawings; none reproduced. Assigned to General Electric Company by Lloyd S. Hartley, Joseph B. Henry, John W. Miller, and William E. Shahan.

The invention relates to the art of making glass-to-metal seals and, more particularly, to improved apparatus for fabricating metal-type cathode ray tube envelopes.

The fabrication is carried out on a rotary machine of the type that is provided with a plurality of work supports or heads, which are moved intermittently to occupy in succession a plurality of cooperative positions with respect to stationary equipment or work stations. The parts are subjected to predetermined fabricating operations in each of the successively located stations.

The work holders, or heads, provide for supporting the parts in the desired position or relationship and for adjusting the glass neck with respect to the metal cone to compensate for variations in the dimensions of the parts. The heads are also provided with means for subjecting the glass to a predetermined amount of push-up during the sealing operation; after the seal is largely made, the vertical force is removed from the neck to allow the same amount of pull-down by the action of gravity on the weight of the glass neck. The face plate seals are accomplished by ring burners, which are raised from the envelopes carried by the machine when the machine is moved, and are lowered into position automatically after each movement of the machine. After the face plates are sealed, their final position is accurately determined by admitting air under pressure to the interior of the bulb and controlling the admission of air in accordance with the position of the face plate. In order to insure uniform heating of the metal cones during the preheating and sealing operation, each of the heads is rotated about its own axis relative to the rotary part of the machine.

There were 13 claims and the following references cited in this patent.

United States Patents

2,063,235, Eisler, Dec. 8, 1936; 2,237,186, Malloy, Apr. 1, 1941; 2,296,307, Power, Sept. 22, 1942; 2,334,123, Perkins, Nov. 9, 1943; 2,335,617, Thomas et al., Nov. 30, 1943; 2,447,158, Cartun, Aug. 17, 1948; 3,455,317, Schneider, Nov. 30, 1948; and 2,715,298, Buttino, Aug. 16, 1955.

Hollow glass rod and method of making same. Patent No. 2,852,425. Filed September 7, 1954. Issued September 16, 1958. No sheets of drawings; none reproduced. Assigned to————————by Samuel M. Shobert.

The method of making hollow tapered glass rod comprising the steps of wetting a plurality of glass threads with a heat-hardenable resin material, gathering all of said threads into an elongated tubular form, pinching said threads together at one end for forming a conically-shaped bundle which is hollow, tensioning all of said threads in said bundle, and curing said resin during said tensioning.

There were 10 claims and no references cited in this patent.

Miscellaneous Processes

Electrostatic coating machine for incandescent lamp envelopes. Patent No. 2,811,131. Filed August 13, 1956. Issued October 29, 1957. No sheets of drawings; none reproduced. Assigned to Westinghouse Electric Corporation by Stanley A. Lopenski, George Meister and Albert W. Wainio.

This invention relates to the manufacture of incandescent lamps and, more particularly, to an automatic machine for electrostatically coating incandescent lamp envelopes.

In the operation of the machine, the bulbs are indexed through a plurality of work stations and are first heated so as to render them substantially uniformly electrically conductive. The coating material is then sprayed as a dry spray into the heated bulbs and an electric field applied to assist in depositing a portion of the sprayed material.

During this operation the bulbs being coated and the spraying nozzle are rotated with respect to one another. The coated bulbs are then lehred to remove substantially all moisture which may be contained therein and preferably the coated bulbs are simultaneously flushed with hot, dry air while lehring to remove more completely any residual moisture. After coating, the spraying nozzle is blown clean so that uncoated material will not remain within the nozzle to be deposited in agglomerate form and thereby impair the quality of the coating. There is also provided a bulb-steaming operation after coating and prior to lehring, wherein a cloud of steam is injected into the coated bulb in order to mat down the coating and cause it to adhere better to the bulb.

The principles of the invention are broadly applicable to the automatic electrostatic deposition of any finely-divided, light-scattering coating material as can be used for rendering diffusing the interior surface of incandescent lamp envelopes. Many different materials may be used for this purpose, such as calcium carbonate and aluminum oxide, but silica is the most desirable material.

There were 11 claims and the following references cited in this patent.

United States Patents

1,655,290, Phelps et al., Jan. 3, 1928; 1,900,104, Hageman et al., Mar. 7, 1933; 2,538,562, Gustin et al., Jan. 16, 1951; 2,569,852, Green, Oct. 2, 1951; 2,626,874, Pipkin, Jan. 27, 1953; and 2,716,620, Green et al., Aug. 30, 1955.

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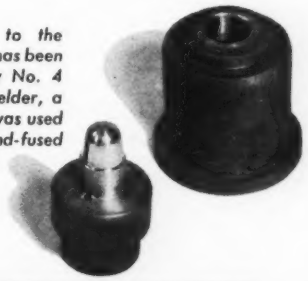

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